# DESIGN RESEARCH ON MATHEMATICS EDUCATION: INVESTIGATING THE DEVELOPMENT OF INDONESIAN FIFTH GRADE STUDENTS IN LEARNING PERCENTAGES

# A THESIS

Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science (M.Sc) in International Master Program on Mathematics Education (IMPoME) Faculty of Teacher Training and Education Sriwijaya University

(In Collaboration between Sriwijaya University and Utrecht University)

By: Yenny Anggreini Sarumaha NIM 20102812003





# FACULTY OF TEACHER TRAINING AND EDUCATION SRIWIJAYA UNIVERSITY

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- 2. The thesis that I had made is original of my mind and had never been presented and proposed to get any other degree from Sriwijaya University or other universities.

This statement was truly made and if in other time that found any fouls in my statement above, I am ready to get any academic sanctions such as cancelation of my degree that I have got through this thesis.

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#### Abstract

Many prior researchers found that percent is hard to teach and hard to learn. It was revealed that many students are confused with the meaning of percent itself. They also cannot see the relation amongst percentages, fractions, decimals, ratios, and proportions. They tend to solve percentage problems using the formal way but become confused in using it when the contexts of problems are changed. For those reasons, a set of instructional activities was designed to help students to find out the meaning of percentages in many situations and to construct a model which help them to solve the percentage problems. This present study is aimed to develop a local instructional theory to support students' development of basic understanding of percentage. In the light of it, design research was chosen as an appropriate mean to achieve the goal. It was held in Pusri Primary School Palembang, grade 5 involving 42 students in total and one classroom teacher. In addition, Pendidikan Matematika Realistik Indonesia (PMRI) which was adapted from Realistic Mathematics Education (RME) was deliberately chosen as the approach in the teaching-learning process in the classroom. This study revealed that using some contexts in learning percentages supports students to understand the meaning of percentages itself. By understanding the meaning of percentages in the context, students become easier to find clues how to solve percentage problems. A percentage bar which is served as a model in this study helps students in learning. Some students use it as a tool for reasoning and also as a tool for calculating, since they realize the benchamrk numbers of percent are easy to calculate using the bar. Other students, who usually use the formal way to solve percentage problem, use the bar as another way to prove the result. Besides, they also can use it to figure out how many out of hundred of the percent asked.

Key concept: context, percentages, model, percentage bar, design research, RME, PMRI.

#### RINGKASAN

**Yenny Anggreini Sarumaha.** Design Research on Mathematics Education: Investigating the Development of Indonesian Fifith Grade Students in Learning Percentages.

Persen adalah salah satu topik yang diajarkan di kelas 5 Sekolah Dasar pada semester kedua di Indonesia. Seyogyanya, topik ini tidak terlepas dari pembahasan mengenai pecahan karena persen sendiri adalah pecahan khusus dengan penyebut 100. Persen juga memiliki kaitan erat dengan desimal dan proporsi atau rasio. Penggunaan persen dalam kehidupan sehari-hari juga tak terhitung banyaknya, misalnya dalam jual beli kita kenal dengan diskon, dalam hal menabung di bank atau membayar angsuran kita kenal dengan konsep bunga, dan lain sebagainya. Namun demikian, beberapa penelitian yang telah dilakukan menunjukkan bahwa banyak ditemukan pada siswa sekolah dan orang dewasa kesalahan dalam penggunaan persen dan perhitungan yang melibatkannya. Lee (1998) dalam penelitiannya menemukan bahwa siswa sering mengalami kesulitan dalam memahami konsep dari persen dan mengaplikasiakannya dalam pemecahan masalah. Reinup (2010) mengemukakan bahwa karena dalam kesehariannya siswa telah diberikan langkah formal bagaimana cara menyelesaikan masalah tentang persen, maka siswa cenderung mengikuti. Hal ini berdampak pada rendahnya kreativitas siswa untuk menemukan pendekatan lain yang bisa digunakan dalam pemecahan masalah.

Untuk itu dirasakan perlu adaya perbaikan agar pemahaman tentang persen dapat dicapai oleh siswa. Salah satu usaha yang bisa dilakukan adalah dengan mengupayakan kegiatan pembelajaran yang terencana dan dapat menjadikannya bermakna bagi siswa. Dalam penelitian ini digunakan pendekatan PMRI yang merupakan adaptasi dari pendekatan RME, (Sembiring, Hoogland, & Dolk, 2010). PMRI memuat tentang penggunaan konteks dan model dalam membantu siswa untuk memahami pelajaran. Konteks yang digunakan dalam penyampaian materi persen ini adalah konteks kegiatan sehari-hari yang dilakukan oleh siswa antara lain, diskon pembelian, komposisi makanan yang tertera pada kemasan, penonton acara pertunjukkan, pendukung olahraga di stadion, dan lain sebagainya. Sedangkan model yang dituju adalah model batang persen. Model adalah suatu alat yang menjembatani dan membantu siswa berkembang dari tahap informal ke tahap formal. Salah satu hal penting dari penggunaan model menurut Van den Heuvel-Panhuizen (2003) adalah model merupakan sebuah jawaban tentang bagaimana siswa-siswa dapat belajar tentang persen.

Penelitian ini bertujuan untuk menginvestigasi serangkaian aktivitas yang telah didesain dalam membantu mengembangkan kemampuan berfikir siswa menkonstruksi model pada materi persen. Penelitian ini menjawab pertanyaan: '*bagaimana perkembangan berfikir siswa dalam mengkonstruksi sebuah model yang dapat membantu memahami materi persen?*' Untuk menjawab pertanyaan tersebut dan mencapai tujuan yang telah disebutkan, penelitian ini menggunakan metode *design research*. Dalam pelaksanaannya, penelitian ini melewati tiga fase, yaitu persiapan, pengimplementasian, dan retrospektif analisis, (Gravemeijer & Cobb, 2006). Sebanyak tiga puluh tujuh siswa kelas 5 Sekolah Dasar Pupuk Sriwijaya (SD Pusri) Palembang terlibat di dalam penelitian ini. Siswa-siswa ini berusia antara 10-11 tahun.

Pada penelitian ini, untuk membantu jalannya proses pembelajaran di kelas, dirancanglah kegiatan instruksional berikut dengan hipotesis tentang trayek belajar siswa. Untuk memperoleh pemahaman dasar mengenai persen, peneliti merancang 6 kegiatan instruksional. Selain itu, pada pelaksanaannya di kelas, siswa akan lebih banyak bekerja dalam kelompok dan akan ada diskusi kelas setelah selesai menyelesaikan sebuah permasalahan. Siswa tidak diajarkan cara menyelsaikan masalah yang berkaitan dengan persen dan mereka diberi kebebasan memilih cara yang digunakan untuk menyelesaikan sebagai salah satu cara membandingkan pemahaman siswa sebelum dan setelah mengikuti proses pembelajaran.

Kegiatan pertama siswa adalah eksplorasi penggunaan persen dalam kehidupan sehari-hari. Siswa dalam kelompoknya diminta membawa dan membuat poster berupa tempelan-tempelan dari produk-produk yang memuat persen, seperti kemasan plastik makanan, minuman, katalog belanja, dan lain-lain. Tidak ada kesulitan yang ditemui siswa dalam pelaksanaannya. Kegiatan kedua saat siswa dihadapkan dengan masalah yang meminta alasan atas jawaban yang diberikan, mereka mengalami sedikit kesulitan. Sebagian besar dari mereka menuliskan jawaban tanpa memberikan penjelasan bagaimana mereka memperoleh jawaban. Hai ini juga menjadi hambatan jalannya diskusi kelas karena siswa banyak yang merasa enggan untuk menyuarakan pendapatnya walaupun mereka mengetahui jawaban yang ditanya. Siswa telah mengenal beberapa nilai persen yang mudah seperti 50 persen, 25 persen, dan 10 persen. Hal ini ditunjukkan dari hasil kegiatan ketiga, dimana siswa diminta menggambarkan nilai persen yang mereka pahami pada sebuah bangun datar. Sebagian siswa bahkan telah mampu melihat adanya hubungan antara persen dan pecahan, seperti menuliskan 25 persen = <sup>1</sup>/<sub>4</sub>.

Kegiatan ketiga ini merupakan kegiatan penting dimana siswa selanjutnya menggunakan model berupa persegi panjang yang dikenal dengan batang persen untuk memahami dan menyelesaikan masalah persen. Penelitian ini juga menunjukkan bahwa dengan mengkonstruksi model, kemampuan berfikir siswa memahami materi persen berkembang. Dalam prakteknya pada kegiatan empat dan lima, siswa masih cenderung menggunakan cara formal dalam menyelesaikan masalah yang berkaitan dengan persen. Tapi tidak jarang mereka menemui kesulitan dan kemudian beralih menggunakan batang persen. Sebagian siswa menggunakan batang persen hanya sebagai alat untuk bernalar atau memvisualisasikan nilai persen tertentu. Sebagian siswa lainnya menjadikan batang persen sebagai alat untuk menghitung karena kemudahannya dalam menyelesaikan nilai persen yang mudah. Namun, sebagian siswa lainnya mampu menggunakan batang persen baik sebagai alat untuk bernalar ataupun sebagai alat untuk menghitung sebagaimana yang diharapkan.

Model pada penelitian ini sejatinya merupakan jembatan yang menghubungkan pengetahuan informal siswa dengan pengetahun formal. Dalam RME batang persen ini merupakan model dari sebuah masalah dan juga bisa dijadikan model untuk menyelesaikan masalah. Karenanya model ini baik digunakan oleh siswa yang agak lambat dan juga siswa yang lebih cepat. Namun, batang persen bukanlah satu-satunya model yang dapat digunakan dalam membantu memahami dan menyelsaikan maslaah persen. Guru juga dapat memperkenalkan garis bilangan ganda atau tabel perbandingan dalam menyelesaikan masalah.

"If people do not believe that mathematics is simple, it is only because they do not realize how complicated life is"

-John Louis von Neumann-

This thesis is my special dedication to my family – especially my father, my mother, and my brothers – for their love and never ending support.

For my beloved partner, thank you so much for your help, your patience and everything you share with me. I hope someday we can create our own masterpiece together.

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> Palembang, Mei 2012 Yenny A Sarumaha

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#### **CHAPTER I**

## **INTRODUCTION**

Percent is prevalent in our daily life. It is one of the most widely used mathematical concepts. By only reading the newspaper or watching television we can be reminded how abundant the use of percent. It is present in the food we eat (e.g., 10% fat), the clothes we wear (e.g., 100% cotton), the financial transactions we carry out (e.g., 2.5% interest), the things we use (e.g., 80% graphite), the games we play (e.g., 75% hits) and the survey reports that we read (e.g., 30% of the population). Parker and Leinhardt (1995) stated that percent is an interesting, exciting, and even beautiful concept—one that bridges ancient mercantile practices and modern ideas of multiplicative structures and mathematical functions. According to Reys (2007), students understand percent when they can use it in many different ways.

Understanding percentage in fact cannot be separated from fractions, decimals, and proportions. Of course one way to represents proportion is by using percentage. Galen et al. (2008) stated that the relationships between fractions, percentages, decimals, and proportions or ratios can be dealt with in a natural way if we make the context as the central feature in teaching, and give students the chance to explore these contexts in many different ways. Why the relationship is so important here because according to Galen et al. (2008) we can easily change between these forms in everyday situations, which help us to interpret the situation and solve the problem. This relationship also helps us to better understand the numbers.

However, some studies which were conducted in this topic revealed that incorrect usage of percent is common among students and adults. Flagrant errors abound, suggesting that often the most basic ideas are unclear. Reinup (2010) affirmed in her study that students are often puzzled which of these meanings of fractions and decimals they must use in different exercises. The meanings which are discussed in the present study are the meaning as rational numbers and the ways to express ratio and relationships, which can also be expressed using percentages. Students' transformation skills are the worst in fraction – percentage transformations, where fractions are used in their classical part-whole sense. The study that was conducted by Lee (1998) resulted that students often find it difficult to conceptualize percent and apply it to solve problems in context. The formal instruction on percent tends to restrict students' creativity and flexibility in their approaches to percent problems. His study was not really different from what Reinup did in her study. Both studies provided the concrete exercises for students to solve with the focused on what kind of strategies that students use in solving the different problem. However, the ideas of students' understanding about percentages and the relation amongst fractions, decimals, and percentages still need to be revealed.

The study conducted by Parker and Leinhardt (1995) resulted the four reasons why percent is hard to learn. The first reason is because percent is a simple pragmatic expression of "so many of this for 100 of that" propagates many multiple and related meanings. Another reason is percent has several meanings at the same time. The third reason is percents use an extremely concise linguistic form and the last reason is that percents have been poorly taught such that students have a limited view of the concept as meaning only part of a whole. These reasons indeed related to the teaching and learning process of percentages in the classroom. What have to be considered here is the way how to teach the lesson to students in order to help them attain the insight of learning percentages.

Realistic Mathematics Education (RME) as an approach which has a more complex and conceptualization of teaching considered the students to be active participants in the teaching learning process. Gravemeijer (1994) affirmed that the very feature of RME is, however, that not only the development of the student is seen as a guiding principle for mathematics education but also the mathematics itself. In the Realistic approach one of the essential features of RME is the didactical use of model. One important finding about this model is stated in Van den Heuvel-Panhuizen (2003) as an answer how students can learn percentages. However, this result therefore cannot be seen as a fixed recipe in which students have few options gaining certain insight in learning, but it is a result which the didactical use of models plays a key role. Kachapova & Kachapov (2011) in their study found that a two-way table helped students in solving a word problem about percentages. What is called by a two-way table in their study indeed is what we know as a ratio table. It also serves as a model that helps students in learning percentages.

Nevertheless, those studies also lead to the question about the design of the lesson. How students develop their understanding in learning percentages have to be in the spotlight. This understanding will be developed by the help of a model. In the present study I am going to use *Pendidikan Matematika Realistik Indonesia* (PMRI) approach which is an adaptation of RME in Indonesian curriculum (Sembiring, Hoogland, & Dolk, 2010) to find out how the model will be constructed from the students. This is also related to the use of contexts in the instructional activities which is relevant with Freudenthal's idea that views mathematics as a human activity instead of seeing mathematics as a subject to be transmitted (Freudenthal, 1991). In the light of it the development of students' understanding in learning percentages will be one of the main issues.

Considering those issues in teaching and learning percentages, this study aims at developing a grounded theory on percentage, especially for young students age 10 or 11 in 5<sup>th</sup>grade. Based on the Indonesian contexts and situations, the researcher aims at developing a local instructional theory to support students' development of basic understanding of percentage. The research question of this study is:

How can we support students' understanding in learning percentages?

#### **CHAPTER II**

#### **THEORETICAL FRAMEWORK**

This chapter provides the theoretical framework that is addressed to construct groundwork of this research study. Literature about percentages is studied to attain the main concepts that are required to solve any problems related to percentage. Moreover, the literature is useful in designing instructional activities in which the main concepts of percentages are taught for children and also in finding how percentage can be connected in daily life.

#### 2.1 Percentage

A key feature of percentage which must be understood in order to have insight into this concept is that a percentage is a relation between two numbers or magnitudes that is expressed by a special ratio, namely 'so-many-out-of-the-hundred' (Van den Heuvel-Panhuizen, 1996). In learning percentages, students should develop insight into the meaning of percentages through using them, and not solely be given definitions. They must be aware of the fact that percentages are always related to something and cannot be compared without taking this 'something' into account. For example, in order to pass the exam, Lena needed to answer 50% of the question correctly. However, she was wrong on 12 problems. Should we congratulate her or not?. Since there is no information about the total number of tasks that Lena had to solve in which the percentage is referring, no judgments can be made about Lena's result.

De Corte, E., Depaepe, F., Op 't Eynde, P & Verschaffel, L, (2005) stated that learning percentages serves different goals, namely computational, conceptual, and application goals.

- Computational goals are the first goals that should be mastered in which students will develop their procedural knowledge to compute percentages. It is not enough since these goals are primarily focused on procedures and recall.
- Therefore, we need the second goal, namely students' development of a deep understanding of the concept "percentage." It needs a good and consistent conceptual knowledge system.

• The third goal is development of skills to apply percentages in all kind of meaningful situations. This goal requires those students' procedural (objective I) and conceptual (objective II) knowledge gets interconnected.

There are also some characteristics of percentages which are described by De Corte, E., Depaepe, F., Op 't Eynde, P & Verschaffel, L, (2005) that should be discovered by solving appropriate tasks and problems.

1. A percentage expresses a relation between two numbers or quantities by means of a ratio. Students need to aware that percentages are always related to something and have, therefore, no meaning without taking into account.

For example: "You need 50% correct answers to succeed. Lena solved 12 tasks wrongly. What do you think? Can we congratulate Lena or not?"

Since the number to which the percentage is referring is missing, no judgment can be made about Lena's performance.

2. Percentages describe a fixed situation representing how different kinds of substances are related to each other.

For example: "Cherry jam which contains 55% of fruit is sold in large (600g) and small pot (300g). Someone forgot to put the percentage of fruit on the small pot. Fill in this missing information. Explain your strategy for finding this percentage. How many grams of fruit does each pot contain? The large one contains?... The small one contains?... Show how you got your answers."

By posing this problem we hope students can overcome the potential misconception that percentages change linearly with the size of the whole.

- 3. The reduction of adding up of percentages has a non linear character. For example: "A whole plus 20% plus 30% is the same as the same whole plus 50%." The decrease or increase of a part behaves asymmetric if it is expressed by percentages. It is caused by the fact that the reference amount changes (in the latter case the reference amount is larger).
- 4. Percentages can be used to describe two different types of situations. (1) They can describe the substances of a whole. For example: to bake bread we need 68% flour, 30% water, 1% yeast, and 1% butter. (2) They can describe situations about a whole that is increased or decreased with a part.

Considering the goals and the characteristics that have to be considered in the teaching

learning percentages, the six instructional activities are designed in such a way. It is more

important that students are able to use percentage in a situation in which they are needed.

(Van den Heuvel-Panhuizen, 1994).

Percentage as part whole relationship describes relative value of the part compared to the whole. Percentages are relationships based on a one-hundred-part whole and it gives relative measure, not an absolute measure (Fosnot & Dolk, 2002). Students do not have to explain

this in this manner, but they have to show an awareness of the fact that percentages are always related to something and that they therefore cannot be compared without taking into account to what they refer (Van den Heuvel-Panhuizen, 1994).

In this study, researcher only focuses on the meaning of percentage as part whole relationship. Researcher only focuses on this meaning because it is the most salient of comparative situations, imaginable for young students in grade 5, and can support students understanding of percentage as relationship based on one-hundred-part whole. In this study, the contextual situations are used as a support in the learning percentage. Those contextual situations are discount, the audience of the performance, the shouting match, and other contextual situations in which percentage play a role.

2.2 The use of model in learning percentages

In learning percentages there are some models that can be used to help students attain the insight of percentage. Models are attributed the role of bridging the gap between the informal understanding connected to the 'real' and imagined reality on the one side, and the understanding of formal system on the other (Van den Heuvel-Panhuizen, 2003). The most important model for percentages is the bar. Van den Heuvel-Panhuizen (2003), stated that during the process of growing understanding of percentage, the bar gradually changes from a concrete context-connected representation to a more abstract representational model that moreover is going to function as an estimation model, and to model that guides the students in choosing the calculations that have to be made.

The bar model refers to a strip on which different scales are depicted at the same time, as a result of which an amount or a quantity can be expressed through different amount or quantity. Galen et al (2008) stated the percentages are written above the bar and the corresponding numbers below the bar, or the other way around. The advantage of the bar is

that it has "body" – area. For children, this part will make them easier to talk in terms of "thewhole" and "the so-much part" of the whole.

Another model that can be used in learning percentages is the double number line. It is a much more abstract model compared with the bar. Working with the model later will lead students to discover the 1% - procedure even though this is not always the easiest way working with this algorithm. Another arithmetic aid in learning percentage is the ratio table. The similarities amongst these three models are they offers the possibility to link numbers and percentages together and they also offers he freedom to make all kinds of interim steps. The difference appears when working with the ratio table, the numbers can be placed in random order. Nevertheless, it gives calculation in more abstract quality, without any support for "so-much part of the whole" – reasoning.

In the present study, some activities are provided to help students construct their own model. The focus of the model that develop during the instructional activities is the percentage bar.

2.3 Realistic Mathematics Education

According to Freudenthal, mathematics should be connected to reality through problem situations. The term "*reality*" means that the problem situation must be experientially real for students. In this research, daily situations are set as the contextual problem situations for children to learn percentages.

2.3.1 Five tenets of realistic mathematics education

The process of designing a sequence of instructional activities that starts with experiencebased activities in this research was inspired by five tenets for realistic mathematics education defined by Treffers (1987) that are described in the following ways:

# 1. Phenomenological exploration

As the first instructional activity, a concrete context is used as the base of mathematical activity. The mathematical activity is not started from a formal level but from a situation that

is experientially real for students. Consequently, this research study employs daily life problems as the contextual situation.

#### 2. Using models and symbols for progressive mathematization

The second tenet of RME is bridging from a concrete level to a more formal level by using models and symbols. Students' informal knowledge as the result of experience-based activities needs to be developed into formal knowledge of percentage. The activity shading the area of some shapes is designed to provide opportunity for students in concrete level working in the more formal level in learning percentages.

#### 3. Using students' own construction

The freedom for students to use their own strategies could direct to the emergence of various solutions that can be used to develop the next learning process. The students' strategies in each activity are discussed in the whole class discussion to support students' acquisition of the basic concepts of percentage. The student-made percentage bar serve as the bases for students to realize the best way in modeling percentage problem.

#### 4. Interactivity

The learning process of students is not merely an individual process, but it is also a social process. The learning process of students can be shortened when students communicate their works and thoughts in the social interaction emerging in the classroom. Activity in shading the area of some shapes is the natural situation for social interaction such as students' agreement in deciding a shape that can be used to represent percentage.

#### 5. Intertwinement

Intertwinement suggests integrating various mathematics topics in one activity. The daily life problems that are used in this research study do not merely support learning percentage. They also support the development of students' number sense.

#### 2.3.2 Emergent modeling

The implementation of the second tenet of RME produces a sequence of models that supported what students get from the concepts of percentage.

Emergent modeling is one of the heuristics for realistic mathematics education in which Gravemeijer (1994) describes how *models-of* a certain situation can become *models-for* more formal reasoning. The levels of emergent modeling from situational to formal reasoning are shown in the following figure:

- 4. Formal
- 3. General
- 2. Referential
- 1. Situational



Figure 2.1. Levels of emergent modeling from situational to formal reasoning (Gravemeijer, 1994)

From The Figure 2.1, the implementation of the four levels of emergent modeling in this research is described as follows:

1. Situational level

Situational level is the basic level of emergent modeling where domain-specific, situational knowledge and strategies are used within the context of the situation. The first activity, when students are asked to show some of their findings of percentage contexts, provides informal knowledge of learning percentage. In this level, students have to realize that the use of percentage is abundant in daily life.

## 2. Referential level

The use of models and strategies in this level refers to the situation described in the problem or, in other words, referential level is the level of *models-of*.

A class discussion encourages students to shift from situational level to referential level when students need to make representations (drawings) as the *models-of* their strategies to show the amount of percent in particular area. This will be developed in the activity shading area.

#### 3. General level

In general level, *models-for* emerge in which the mathematical focus on strategies dominates over the reference to the contextual problem. Students then gradually move from the percentage bar to the use of double number lines. However, percentage bar also can serve as model for in learning percentage. But if it is compared to double number lines, percentage bar is the concrete one.

# 4. Formal level

In formal level, reasoning with conventional symbolizations is no longer dependent on the support of *models-for* mathematics activity. The focus of the discussion moves to solving application situations in many different ways.

# 2.4 Percentages in the Indonesian Curriculum

In Indonesian National Curriculum, percentage is taught when for students in the 5<sup>th</sup> grade of second semester of primary school. Before they learn about percentage, they have already learnt about fraction and its operation in the 3<sup>rd</sup> and 4<sup>th</sup> grade. The following table shows the overview of Chapter 5 where students start learning percentage.

	Standard Competence	Basic Competence
5.	Using fraction in solving problems	5.1 Converting fraction to <b>percentage</b> and decimal form and vice versa
		5.2 Adding and Subtracting many form of fraction
		5.3 Multiplying and dividing many form of fraction
		5.4 Using fraction in solving proportion and ratio problems.

Table 1. Standard competence and basic competence in Indonesian Curriculum

In this curriculum the topic about percentages is included in the first basic competence, namely changing fractions to percent and decimal forms and vice versa In other words, this topic cannot be separated from learning fractions and decimal. Since the topics related each other, it is not surprising in the reality only short time will be allocated to conduct each topic. This situation leads to the process of learning which directly go to the formal way. Students are taught using the procedure and algorithm that can be used to solve percentage problem without meaning of percentage itself. Considering this fact learning mathematics becomes meaningless if no action taken here. There will be a need to support students' development of understanding of percentage in which this research intended to.

#### 2.5 Emergent Perspective

Gravemeijer & Cobb (2006) stated that a key element in the ongoing process of experimentation is the interpretation of both the students' reasoning and learning and the means by which that learning is supported and organized. They contend that it is important to be explicit about how one is going about interpreting what is going on in the classroom. Before starting the process of learning, it is conjectured that the students have their own belief about their own roles, the others' roles, the teacher's roles and the mathematics that students learn. In this study, during the process of learning, the teacher initiates and develops the social norms that sustain classroom culture characterized by explanation and justification of solution, and argumentation: attempting to make sense of explanation given by others, indicating agreement and disagreement, and questioning alternatives in solutions in which a

conflict in interpretation or solution has become apparent (Gravemeijer & Cobb, 2006). The framework used for interpreting classroom discourse and communication is the emergent perspective.

Automotjer & 6000, 2000)		
Social Perspective	Psychological Perspective	
Classroom social norms	Beliefs about our own role, others' roles, and the	
	general nature of mathematical activity	
Socio-mathematical norms	Specifically mathematical beliefs and values	
Classroom mathematical practices	Mathematical conceptions and activity	

Table 2. An interpretative framework for analyzing individual and collective activity at the classroom level (Gravemeijer & Cobb, 2006)

According to Gravemeijer & Cobb (2006), there are three aspects of emergent perspective that are elaborated. The explanation and discussion of these aspects is relatively brief because the aim is to develop the rationale for the theoretical framework rather than to present detailed analyses of these aspects.

The first aspect of emergent perspective is the social norms that are established in the classroom. Social norms refer to the expected ways of acting and explaining that is established through negotiation between the teacher and students. The examples of social norms are obligations for students to explain and justify solutions in front of the class, to make sense of explanation given by other students, and to give opinion indicating agreement and disagreement.

The second aspect is socio-mathematical norms. Socio-mathematical norms refer to the expected ways of explicating and acting in the whole class discussion that are specific to mathematics. The examples of socio-mathematical norms are the different mathematical solutions, and some mathematical explanations and justifications. The socio-mathematical norms aspect is one of the main focuses in this study. With the respect of the socio-mathematical norms, students' explanation and reasoning which deal with investigating contextual problems about percentage are explored.

The last social aspect of emergent perspective is classroom mathematical practices. Classroom mathematical practice refers to the normative ways of acting, communicating, symbolizing mathematically that are specific to particular mathematical ideas or concepts. Students interpretation or ideas about percentage, the way they make a visual model of percentage, and the way they work with percentage will be analyzed.

According to the discussion of the framework, the general research question in this study is elaborated into two specific sub questions as follows.

- 1. How can contexts support student's understanding of the meaning of percentages?
- 2. How do students construct a model in developing their understanding in learning percentages?

#### **CHAPTER III**

#### METHODOLOGY

The issues that will be discussed in this chapter are: (1) design research methodology, (2) data collection, including the preparation phase, preliminary teaching experiment, teaching experiment, post test, and validity and reliability of the data, (3) data analysis, including pre test, preliminary teaching experiment, teaching experiment, and post test.

#### 3.1 Research approach

Gravemeijer & Cobb, (2006) stated that design research is a type of research methods aimed to develop theories about both the process of learning and the means that are designed to support that learning. The main aim of this study is to contribute to an empirically grounded instruction theory for percentages. In the present study, the researcher is interested in how to promote students' understanding of percentages. Therefore, a sequence of activities was developed as means to improve educational practices in learning percentages for grade 5 of primary school in Indonesia. To answer the research question and achieve the research goals, this study is a type of research methods, namely design research.

There are three phases of conducting a design experiment which are preparing experiment, experimenting in the classroom, and retrospective analysis (Gravemeijer & Cobb, 2006). We will now describe these three phases of a design research.

1. Preparing for the Experiment

The aim of preliminary phase of a design research is to formulate a conjectured local instructional theory that can be elaborated and refined while conducting the experiment. The crucial issue in this phase is that of clarifying its theoretical intent (Gravemeijer & Cobb, 2006). In this phase, a sequence of instructional activities containing conjectures of students' strategies and thinking is developed. The conjectured Hypothetical Learning Trajectory

(HLT) is dynamic and could be adjusted to the students' actual learning during the teaching experiment. The pre-knowledge of the students who were the subjects in the teaching experiment period is useful to be investigated. It is important in determining the starting points of the instructional activities and adjusting the initial HLT.

#### 2. Teaching Experiment

Gravemeijer and Cobb, (2006) affirmed that the purpose of design experiment is both to test and to improve the conjectured local instructional theory that was developed in the preliminary phase. The teaching experiment emphasizes that ideas and conjectures could be adjusted while interpreting students' learning process. In the present study, there were two cycles of teaching experiment which was divided into six lessons. The first cycle was a pilot experiment. The goal of the pilot experiment is to adjust and to improve the initial HLT in order to get a better design for the second cycle. It was held in a small group of grade 5 students which consists of 5 students. The second cycle involved 37 students in a classroom. Before doing the teaching experiment, the teacher and the researcher discussed the upcoming activity, and after each lesson, the teacher and the researcher reflected on the whole class performance.

# 3. Retrospective Analysis

In this phase, all data that have already been gathered from the teaching experiment were analyzed. The result of the retrospective analysis is used to answer the research questions, to draw a conclusion, and to redesign the HLT. In general, the aim of the retrospective analysis is to develop a well considered and empirically grounded local instruction theory.

## 3.2 Data Collection

#### 3.2.1 Preparation Phase

The aim of the preparation phase is to get the general information related to the students that were the subject of the study, the teacher who collaborated with the researcher in conducting the study, and the learning environment of the class where the study was conducted. There were some sorts of data that had been collected as following.

#### 1. Classroom observation

We conducted classroom observations which were aimed to get the feeling how mathematics lessons are going on in the class. It also made students become familiar with the researcher before the experiment in order to avoid the feeling of insecure or strange. The researcher sat on the back of the classroom and observed the whole mathematics lesson. Notes had been taken and there had been informal interviews with the students when they made their task. The classroom observation scheme can be seen on Appendix 2.

2. Interview with the teacher

An interview had been held with the teacher before the experiment to get more sense of how mathematics classroom is going to be taught. There were some questions about the teacher's educational background, her experience with *Pendidikan Matematika Realistik Indonesia* (PMRI) and the topic that she has taught, and some information related to the students that cannot be gained from observation. The interview scheme can be seen on Appendix 3. There were also some questions later on based on the findings from the classroom observations. The researcher used recording tools to record the interview.

3. Studying the documents needed

To know more how mathematics has been taught in the classroom, researcher studied the text book, worksheet book, and other documents that used in learning mathematics

4. Pre-test

A written pre-test (see Appendix 5) were given to the 5 students who participated in the pilot experiment and to the 37 students who participated in the teaching experiment. This written pre-test had been followed by interviews with some students related to their answers.

5. Interview with some students

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An interview had been conducted with some students after the pre-test in order to get more information about their answers of the questions on the test. Five students in the pilot experiment and four students from the teaching experiment class had been interviewed. These four students were chosen based on teacher's suggestions, and they were the members of a focused group on the teaching experiment phase. The researcher recorded the entire interview using the audio recorder with the help of her colleague.

#### 3.2.2 Preliminary teaching experiment (first cycle)

The preliminary teaching experiment is a bridge between the preliminary design and the teaching experiment phase. This preliminary teaching experiment was held in a small group of grade 5 students which consists of 5 students in six lessons. These students were selected by considering the teacher's suggestions and they were not the member of the class where the teaching experiment (second cycle) phase had been conducted. The researcher in this phase had a role as a teacher and the entire learning activities had been recorded using a video camera and is observed by taking notes. Students' written works from all six instructional activities were also collected during this preliminary teaching experiment. The purposes of the preliminary teaching experiment activities were:

# 1. Investigating pre-knowledge of students

Besides giving the written pre-test to the students in the pilot experiment, the preliminary teaching experiment also aimed to give the information about the pre-knowledge of the students. Finding out this pre-knowledge of the students and whole group performance during this activity was important for the starting point of the instructional activities and for adjusting the initial HLT.

2. Adjusting the initial HLT

The main objective of the preliminary teaching experiment is collecting data to try out the initial HLT. The initial HLT was tried out and the observations of students' actual learning process were employed to make adjustments to the HLT.

#### 3.2.3 Teaching experiment (second cycle)

Data collection in the teaching experiment phase is aiming at trying out the HLT that is already improved based on the result of the preliminary teaching experiment. Since the classroom teacher conducted the learning process, researcher and the teacher design Lesson Plans for each meeting (see Appendix 6) beforehand. There were some types of data as following will be collected.

## 1. Pre-test

The written pre-test had been given to 37 students who were the subject of the study at the beginning of the lesson. The written pre-test that was used in this phase was the new version of the pre-test after it had been adjusted, if necessary, based on the result of the pre-test in the Preliminary Teaching Experiment (first cycle).

2. Classroom observation

One class of fifth graders which consisted of 37 students was the subject of this present study. This phase also involved one mathematics teacher and one researcher's colleague. Six instructional activities that had already improved were tried out with the whole class. The focus on the observation was the 4 students who already been chosen beforehand based on teacher's suggestions. These students were set as a group. The researcher focused on doing the observation while the teacher of the class did the teaching.

The researcher with the help of her colleague recorded the entire learning activities using a video camera which was located near the focused group. Written field notes were also taken by the researcher and her colleague during the learning activities. The timing of the

interesting moments had been written down on the notes based on the time showed on the video camera.

#### 3. Group observation

The interaction within focus group was observed. Using the video camera which was located near the focus group, it was easy to make adjustment in order to get the clear video of the interactions within the group. There was also the informal interview or short talks with the students in the focus group in order to get more information about their works. The written field notes were also taken during the observation.

4. Students' written work

Written works of the 4 students in the focus group from all six instructional activities had been collected. The researcher with the help of her colleague collected posters and worksheet from the students.

# 3.2.4 Post-test

The post-test aims at getting information about what students have learnt during the preliminary teaching experiment (first cycle) and the teaching experiment (second cycle). This test was the written test that had been held after the last activity (see Appendix 8). The post-test had been given to the five students who participated in the preliminary teaching experiment and to whole class in the teaching experiment. After giving the written post-test, the researcher with the help of her colleague held an interview session with all students in the preliminary teaching experiment and four students in the focus group. This interview was aimed as a justification for students' result in the post-test and their reasoning in answering the problems given.

# 3.2.5 Validity and Reliability

In this present study, various kinds of data had been gathered. There were video recordings of classroom observations and group observations, written field notes, interviews, students'

written work, students' written test, and students' reflection. The entire learning activities were recorded using a video recording and all written works from the focused groups were also collected. These various kinds of data that were related to the students' learning process had been used as a base of data triangulation that in turn contributed to the internal validity of the present study. The HLT that was compared with the actual learning in the teaching experiment also contributed to the internal validity of the present study. We contributed to the internal validity of the study by registration the data from the video camera.

#### 3.3 Data analysis

#### 3.3.1 Pre-test

The written pre-test was collected from five students in the first cycle and students in the second cycle of teaching experiment. Students' strategies in answering the problems had been examined by the researcher and her colleague. The written pre-test from the students in the first cycle by considering the interview session gave the information about the pre-knowledge of students in learning percentages. This had been the starting point in conducting the preliminary teaching experiment and it gave information which was related to the initial HLT. Moreover, the improvement of the problem in the pre-test which had been given in the first cycle was used in the second cycle to improve the validity of the data and the reliability of the test. The written pre-test from the students in the second cycle and the interview session gave more information of what students have already known and what they have not known about percentages. The result had also been the consideration of the focus group later on and also been the starting point in conducting the teaching experiment.

#### 3.3.2 Preliminary Teaching Experiment (first cycle)

In this phase, data from classroom observation and students' written work had been analyzed by the researcher and her colleague. In analyzing the video, the recordings had been watched and chosen based on the timing of interesting moments that have already written on the field notes. The transcripts of the interesting moments had also been provided. The analysis of the preliminary teaching experiment had been done by comparing the HLT with the actual learning taking place. The result of the analysis had been used to improve the HLT that had been used in the second cycle.

#### 3.3.3 Teaching Experiment

In this phase, data of classroom observations, group observations and students' written work had been collected and had been analyzed by the researcher and her colleague. The video recordings had been treated in the same way as it was in the preliminary teaching experiment phase. By considering the written field notes and students' written work, the actual learning had been compared with the improved HLT. The result of the analysis had been done in order to get information that can be used to answer the research question, to draw conclusion, and redesign the HLT.

# 3.3.4 Post-test

The written post-test had been analyzed by examining the result of the students' written posttest and the interview results related to the strategies and students' reasoning in answering the problems. The result of the analysis had been compared with the result of the students' written pre-test. The purpose of the comparing was to see what students have learnt during the experiment. The result of the analysis contributed to the conclusions of the present study.

3.4 Research subject and the timeline of the research

Thirty seven students and a classroom teacher of grade 5 in Indonesian Primary School in Palembang involved in the present study. The school here was Pusri Primary School. The students were about 10 to 11 years old. Pusri Primary School Palembang has been involved in the *Pendidikan Realistik Indonesia* or Realistic Mathematics Education project since 2010.

The timeline of the present study was summarizing in the table as follows:

Description	Date
Preliminary design	1
Studying literature and designing initial HLT	September 2011 – Januari 2012
Discussion with the teacher	Februari 2012
Preliminary teaching experiment	·
Pre-test	February 22, 2012
Try out "Percentage around us " activity	February 29, 2012
Try out "Making sense of percent" activity	
Try out "The audience" activity	March 5, 2012
Try out "The card game" activity	March 8, 2012
Try out "Comparing two theaters" activity	March 12, 2012
Try out "The shouting match" activity	March 15, 2012
Try out "Own production" activity	March 19, 2012
Post-test	March 22, 2012
Analyzing the preliminary teaching experiment and Im	proved the HLT
Discussion with the teacher	March 26-27, 2012
Preparation for teaching experiment	March 27-31, 2012
Teaching experiment	
Pre-test	April 2, 2012
Lesson 1: "Percentage around us" activity and classroom	
discussion	
Lesson 2: "Making sense of percent" activity and	April 22, 2012
classroom discussion	
Lesson 3: "The audience" activity and classroom	April 23, 2012
discussion	
Lesson 4; "The card games" and "Comparing two	April 26, 2012
theaters" activity and classroom discussion	
Lesson 5: "The shouting match" activity	April 27, 2012
Lesson 6: "Own production" activity	April 30, 2012
Post-test	May 5, 2012

Table 3.	Timeline	research	study
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#### **CHAPTER IV**

### HYPOTHETICAL LEARNING TRAJECTORY

### Introduction

Hypothetical learning trajectory served as a term to identify and to describe relevant aspects associated with a mathematics lesson plan, including: a description of the students' mathematical goals, starting position (what students have already learnt or their informal knowledge), the mathematical activities (including the tasks or problems, that students work on to achieve the goals), and a hypothetical path that describes the students learning process. Therefore, in this chapter I would like to describe the starting point of the students, the learning goals, activities that allow me to reach the goals and the conjectures of students' thinking in the HLT.

My departure point in this study is students' current knowledge and ability. Most students in grade 5 indeed are familiar with newspaper or television. Only by reading the newspaper or watching television to be reminded that percent is one of the most widely used mathematical concepts. However, Reys, et al (2007) stated that incorrect usage of percent is common among secondary students and adults. Flagrant errors abound, suggesting that often the most basic ideas are unclear.

Besides the informal knowledge that students experience in daily life, the starting point of the knowledge that students have already had before learning percentages also have to be attained. Percents should be introduced only after students thoroughly understand fractions and decimals and have experience with ratios and proportions. As is true for decimals and fractions, percents express a relationship between two numbers. An error on such a fundamental idea suggests that students did not know that 100 is the comparison base for percent. This is what also affirmed by Reys et al (2007) and Van den Heuvel Panhuizen, (1996) that a key feature of percentage – which must be understood in order to have insight

into this concept – is that a percentage is a relation between two numbers or magnitudes that is expressed by a special ratio, namely, 'so-many-out-of-the-hundred'.

This present research uses many daily life contexts such as discount, theater buildings, and some other contexts in which percentage plays an important role. As the starting point, this study designs an activity to assess informal knowledge of Students on percentage. In Realistic Mathematics Education where teaching is built on the informal knowledge of the students, the teaching of percentage could start with assessing what the students already know about percentage (Van den Heuvel-Panhuizen, 1994). After that, to give students opportunity to explore the meaning of percentage, some contexts related to part whole relationship are elaborated.

In this HLT, there are several learning goals expected to be reached by the students during the series of lessons in three weeks period. To reach the goals formulated, we designed a sequence of instructional learning for percentages which consists of six activities, which are elaborated as follows.

### **General starting point**

In the Indonesian curriculum, five grade students of primary schools in the second semester have already learnt about fractions, decimals, and have already had experienced working with the ratio and proportion problems.

- Students start to learn about fractions from the second semester of grade three ages 8-9. They learn about the simplest fraction – unit fractions and start to make visualization of them. In the second semester of grade four ages 9-10, students continue their learning about fractions including more complex fractions and their visualizations. They also learn to do operation with fraction such as addition and subtraction operation.
- 2. Students have learnt about in the second semester of grade four. They learn decimal right after they learn about fractions and their operations.

- Students have learnt to transform fraction into decimals and vice versa in the second semester of grade four. They have experienced solving some problems which includes fractions and decimals problems.
- 4. Students have experienced solving some problems-application problems of fraction and decimals which related to the ratio and proportions.

The topic about percentages is a new topic for them in the beginning of the second semester after they have learnt all those topics before.

### The first activity

- a. Activity: Percentage around us
- b. Pre knowledge: Students have ever heard the word "percent", and they have ever seen in daily life.
- c. Mathematical idea: Exploring the informal knowledge of percentages
- d. Learning goals:

### Knowledge

Students recognize the use of percents in some situations.

Students identify and list some situations in daily life that use percentages.

Students recognize percent means so many out of a hundred.

## Skill

Students demonstrate how to make a categorization of the use of percentages in certain ways by making poster.

### Attitude

Students express their point of view of some situations which need the use of percentage and why it is needed.

Students appreciate their friends' works by giving comment.

e. Starting positions

# Knowledge

Informal knowledge:

- Students have seen some situations using percentages.

Formal knowledge:

- Students have already learnt about fractions and decimals and have experience working with ratio and proportion.
- Students have already learnt about basic operations in fractions and decimals, such as addition, subtractions, multiplications, and divisions.

### Skills

- Students are able to demonstrate their ability to do calculation using fractions and decimals.

### Attitude

- Students show consideration where they could use fractions or decimals in solving problems.
- f. Classroom activity:

Students are asked to make categorization together in their group of the percentage product that they have already found.

Some examples of the use of percents in daily life that can be shown to the class as a part of discussion,



They are asked later to walk around to see other posters that have been made by other groups. By doing this activity, students will learn to appreciate others productions. They express their

point of view of what their reason is making categorization in such a way and give comments about the others products.

Students perform the categorization by making a poster in a big paper. They probably stick those products in order thoroughly, or just stick only one product of each situation as an example.

g. Conjecture of students' thinking:

Students recognize the use of percentages in some situations and list those situations, for example on the back of plastic package of instant noodle or chocolate bag, on the bottle of jam or milk. Students categorize the situations in certain ways. The way is determined by their discussion in group. For example they will categorize the products based on the context what the products show about, or another group will decided to categorize based on the number of percents stated, less than 50 percent and more than 50%.

Students categorize their findings based on their discussion in their own group. Probably some groups will list it and categorize based on the contexts that used, based on the number – less than or larger than 50%, based on the model or representation of the percentage – using a figure, only numbers, and etc. For example the data of vote from the newspaper is presented by the use of pie chart which has some colors and each color stated the different number of percents, on the brochure of department store the discount only represented by number – 20%, 50%, and etc.

Students recognize some situations where the use of percentages play role. Later on, the discussion will lead to find out what situation is mostly abundant of the use of percentages. Students recognize that percents only related to discount. It will happen since probably there is no one in their groups brings other contexts or situations that represent the use of percents. If it is happened, teacher will let students do in their own way and then later she will ask after the students stick their posters on the wall and walk around to see their friends' posters.

#### h. Class discussion:

After students walk around and try to find any similarities and differences between their posters and other posters, teacher holds whole class discussion. Teacher then asks students what kind of products that show the use of percent after sightseeing they have done. Here, teacher also asks students whether they know the meaning of the symbol "%".

Another informal knowledge that can be appeared from students is the use of percentages in the discount context. What about if the price is 90% discount, what it means for the customer and also for the seller. This kind of question aims to see whether students realize that percentage close to 100 means almost everything and percentage close to 0 means almost nothing. This also digs students' daily activity when they go with their parent to the supermarket and get discount as an informal knowledge that they have. The idea that will be attained from this activity is percent means so many out of hundred. Another starting points as the formal knowledge that have been attained by Students before joining this lesson is the use of fractions and decimals. They later will be asked the form of percents stated in fractions or decimals, and so on.

Students show consideration of why their groups make such a kind of categorization and express point of view to other students' work. They will give comments on their friends' work and compare it with their own work. Another respond will probably come by suggestions why this or that categorization is the best one.

In general, the discussion will lead into some points.

- the knowledge of situations (discounts, fats, oil productions, etc-depend on students' products)
- the knowledge of different numbers (10%, 50%, and etc). This is also related to the fractions or even decimals forms that can be shown by the percentage given.
- the different meaning of numbers (measuring numbers, quantities, etc)

Whole class discussion is intended to find out the informal knowledge of percentage that students have. This is the goal that would be attained by the teacher after conducting the first activity. What students have known about percentages and the context in which students are familiar with will be the next attention for teacher and researcher.

### The second activity

- a. Activity: Making sense of percent
- b. Starting point:

#### Knowledge

- Students know the use of percent in daily life.
- Students recognize percent means so many out of hundred

### Attitude

- Students can express their point of view of some situations which need the use of percentage and why it is needed
- c. Mathematical idea:
- Percent means so-many-out-of-hundred
- Percentage describes part whole relationship
- Visual representation of percents, as in a pie chart
- Positive and negative growth described by means of percent.
- d. Leaning goal:

### Knowledge

- Students develop the meaning of percent as so many out of hundred in some situations
- Students understand the characteristics of percents, as follow

According to De Corte, E., Depaepe, F., 'T Eynde, P., & Vershaffel, L. (2005), there are some characteristics of percentages that should be discovered by solving appropriate tasks and problems.

- A percentage expresses a relation between two numbers or quantities by means of a ratio. Students need to aware that percentages are always related to something and have, therefore, no meaning without taking into account.
- Percentages describe a fixed situation representing how different kinds of substances are related to each other.
- The reduction of adding up of percentages has a non linear character
- Percentages can be used to describe two different types of situations.

### Skills

- Students can determine percents given the whole and a part

### Attitude

- Students can express their point of view in answering the problems given.
- e. Classroom activity:

These problems has been taken from the book "Per Sense" by Holt, Rinehart, and Winston

(2003) and adapted into Indonesian contexts.

1. The twin discount

After finishing their purchases at the book store, twins Lyla and Ana taked about their books price. Ana said, "We both got a 10 percent discount, yet we did not get the same *rupiah* amount. I saved Rp4000, and you save only Rp1000."

"Oh," Lyla said, "I can live with it".

Is it possible to get the same percent discount and not get the same amount of money? Explain your answer.

2. The Best Price Ever

A store advertised, "Best price ever! 40 percent discount on all items!"

Is it really the best price? The manager of the store says yes, but a customer says no.

Do you agree with the manager or the customer? Explain why.

3. Budget Trouble

The student council president was explaining his budget plan: "This pie represents the school budget: 50 percent of the money goes for books, 25 percent for lunch improvements, and 35 percent for the student council president"

"Wait!" said the treasurer. "That adds up to 110 percent!"



Dark blue: School budget Blue: Lunch Light blue: President

Is there a problem with the budget?

Explain.

4. The Discount Personal Radio

Lina: "Win, look here. There is a 25 percent discount on this Rp80.000 personal stereo. You know, it's the one I wanted to buy. I need only Rp60.000 now."

Win: "You need only Rp60.000? That doesn't seem right to me"

If you were Lina, how would you explain your answer to Win?

5. The Price War

Two shopkeepers are comparing their prices, Jamie's store sells a phone for Rp200.000. Mike's store sells the same phone for Rp400.000. Jamie says, "Your store price is 100 percent more expensive!"

"That's not true," says Mike. "Your store price is only 50 percent less."

Who is right?

f. Conjecture of students' thinking:

Problem 1

This problem deals with the relative nature of percent. Ana may have gotten a Rp40.000 pair of pants for Rp36.000, while Lyla may have purchase a Rp10.000 T-shirt for Rp9.000. Students do not have to find these amounts, but some may come up with them.

Answer: Yes, it is possible. A 10 percent discount on a higher-priced item represents a large *rupiah* amount saved than the *rupiah* amount saved with a 10 percent discount on a lowerpriced item. The only instance in which a 10 percent discount represents the same *rupiah* amount saved is when both items have the same original price.

If students were able to understand this problem, I probably will ask following question:

Would it work the other way around? Can two people get the same amount of discount and not the same percent discount?

Answer: Yes. For example, suppose Ana buys an Rp800.000 tape. With a 50 percent discount, she saves Rp400.000. If Lyla buys a Rp1.000.000 tape with a 40 percent discount, she also saves Rp400.000.

#### Problem 2

This story emphasizes the relative nature of percent. It is possible that a 20 percent discount will result in a better bargain than a 40 percent discount depending on the base price of the item and various factors such as markup and product quality.

Answer will vary. Some students may agree with the manager, saying that it is very possible that a 40 percent discount allows for the best prices he has ever offered. Other students may agree with the customer, saying that the customer may have seen identical items on sale at a different store. Some students may say that stores offering a 40 percent discount do not have the lowest prices since stores offering a 100 percent discount would have even better price.

### Problem 3

Yes, there is a problem with the budget. The percents of the budget used for the three areas must add up to 100 percent. Some students might suggest allocation 50 percent of the budget

for books and 25 percent each for the lunch improvements and the student council (not just the president).

The key point implied in the story concerns the identification of 100 percent as the maximum. Find out how many students consider this concept to be self-evident.

In addition, considering the pie chart given, students probably relate it to the fraction or decimal forms. This is can be strategy to make justification of their answers.

#### Problem 4

Explanation will vary. One possibility follows:

The original price of the stereo is Rp80.000. It is on sale at a 25 percent discount. Some Students know that 25 percent equals one-quarter. One-quarter of Rp80.000 is Rp20.000,00, so, after subtracting Rp20.000 from Rp80.000 to find the sale price.

Some Students may use a different strategy here: determine the sale price as <sup>3</sup>/<sub>4</sub> of the regular price.

#### Problem 5

This problem is an example of the relative nature of percent. Percents are only understandable when compared to some base value.

Answer: Both shopkeepers are right. Jamie is correct in saying that Mike's price of Rp400.000 is 100 percent higher than her price of Rp200.000. Mike is also correct in saying that Jamie's price of Rp200.000 is 50 percent less than his price of Rp400.000. The two statements are equivalent

g. Classroom discussion:

After discussing in pairs, some students are asked to represent their answers and give explanation. Other students are asked to give opinions or other strategies in solving it. The problems will be discussed together one by one. For example, for the first problem one pair of students will give their answer and follow by other students' responses. The maximum responses are three responses. Before they move to the next problems, teacher will ask students to conclude the result of the discussion of the first problem.

# The third activity

- 1. Activity: The audience
- 2. Starting Point:

### Knowledge

- Students are familiar of some situations which included percent
- Students understand percents as so many out of hundred
- Students understand the characteristics of percent.

## Skill

- Students are able to determine percent given the whole and a part

### Attitude

- Students show consideration working with percents based on their characteristics
- 3. Mathematical ideas:
- Percent means so many out of hundred
- Percentages describe part whole relationship.
- Percents that are relatively easy to estimate are known as benchmark percents
- 4. Learning goals:

### Knowledge

- Students are able to estimate percents
- Students construct a visual model of percent
- Students recognize the relationship between a fraction and a percent.

## Skill

- Students demonstrate their ability to make a visual model of percents.

- Students practice to make a visual model of percent in some shapes.

Attitude

- Students show consideration make a visual model of percent and determine the percent shown.
- 5. Classroom activity:

Students work with their worksheet individually. After they finish their work, they are asked to discuss in duos.

Some students will share their works in front of the class while the other students give comments or share their opinion.

Problem:

There are some performances that are held every month. Shade in the audience section of the room based on your own figure to show what percent of the room you think will be used for each show

1. A pop concert

All audience in the hall will stand up, no chair provided for the audience.

2. A historical play

All audience has seats and no one will stand during the performance.

3. A circus show

There are seats provided and the audience will not allow standing.

h. Conjecture of students' thinking

This context gives students the opportunity to make their knowledge visible in drawings. Students show what percent of the seating area of a theater they think would be filled for various events by shading in a section of the figure for each event.

Since no figure is provided here, students do their own production to determine what figure as a place for the audience section. They will come with the different shapes of figures. Moreover, this problem contains most of the relevant things students should know about the key benchmark percents—percents that are relatively easy to estimate. Students should also get a feeling for the magnitude of 25 percent, 50 percent, and 100 percent. Some students probably will come to the fractions first and then transform them into percents forms. This is possible because the students have already learnt about fractions before.

From this problem, students are asked to construct and use visual model of percent. This is an open ended problem in which students can use their informal knowledge and prior knowledge to estimate the amount of audience in the show room.

The answers will be vary. Probably, students will deal with the coordination between the shading area and percent. All of the responses will be accepted, as long as the shaded portion of the picture and the percent roughly correspond. For example, if one student likes historical plays, he or she may expect a large audience. Also, students may choose fractions that cannot be expressed using easy benchmark percents.

i. Classroom discussion

After students discuss in pairs their solution, some of them are asked to represent their answer in front of the class. Students give their reasons in answering the problems. Other students who have different shapes from the previous students will be asked to present their answer in front of the class and compare them. The other students are asked to give comments.

They will see correspond between the shaded area and the percentage given. The discussion will be led to the question what makes it is hard to determine the percent. It is probably because of the figures or the percentages.

For the practice, teacher provides other shapes of the audience section to make students confident with their answers. This activity will encourage them to conclude which the better shape for representing the percents is. This is the first introduction of the use of model in learning percentages.

# The fourth activity

This activity will be divided into two activities.

a. Activity 1: The card game (15-20 minutes)

Activity 2: Comparing two theaters

b. Starting points:

## Knowledge

- Students understand the part whole relationship
- Students know benchmarks percents
- Students understand the relation between fractions, decimals, and percents
- Students can relate the benchmark of percents into a visual model.

## Skill

- Students are able to draw a visual model of percents

### Attitude

- Students show consideration what is the better visual model to represent the percents.
- c. Mathematical idea:
- Relation between fractions and percents
- Percentage bar as a model in solving percent problem
- d. Learning goals:

# Knowledge

- Students develop a visual model of percent
- Students recognize the relationship between a fraction and a percent
- Students understand the percentage bar

### Skill

- Students are able to use a visual model of percent to solve the percentage problems
- Students demonstrate their ability to make relationship between fractions, percents

#### Attitude

- Students show consideration about the visual model that they will use in representing the percent and in solving the percentage problems.
- e. Classroom activity:

#### First activity

Teacher distributes the papers to the students. Each student gets one paper. Students will be asked to write down the percentage or the fraction or the decimals on one side and the other form on the other side. For example if student in the first side writes down 25%, the other side she or he writes  $\frac{1}{4}$ 

Two students randomly chosen by the teacher and are asked to play a game in front of the class as an example for the whole class. One student mentions what the number on his or her first side of paper and the other student tries to guess another form of the number given which is stated on the back side of his paper.

Later on, all students in the classroom try to play the game in duos. They can change their partner after their card has already been played. This game will be held for about 15 minutes. The teacher then asks some students what they have got from the games-the question and the answer they have given.

#### Second activity

Students work with their worksheet and discuss in their group.

#### Problem:

Swarna Dwipa has about 300 seats. It is rather small compared to the Sriwijaya Sport Convention Center (SSCC) building, which can seat four times as many people. Last night both buildings had a 35 percent attendance rate. About how many people attended the events at each building?

f. Conjecture of Students' thinking

#### Answer:

Students will use fractions in solving problem. Since 35 percent of 300 is 105, 105 people attended the event at the Swarna Dwipa. Since 35 percent of 1200 is 420, 420 people attend the event at SSCC building.

Students will use decimals in solving problem. They convert first 35 percent into 0.35 and then multiply it by 300 to get 105 for Swarna Dwipa. They do the same way with the SSCC building.

Students will make proportion in solving the problem. 35/100 = 105/300 for the Swarna Dwipa. They get 105 as the result. And for SSCC building they get 420 as the result by making 35/100 = 420/1200.

Students will use benchmark percent in solving the problem. Since 35 percent is 10 percent plus 25 percent, they first find 10 percent of 300 and then find 25 percent of 300. After that, they add the two results. They do the same way with the SSCC building's attendance.

If in solving this problem, students face difficulty, teacher suggests them to make representation of the seats by using shaded area like what they have already learnt in the previous activity. Students are expected to use the visualization of the problem which leads to the better one, namely percentage bar.

g. Classroom discussion

In the discussion part, some students are asked to give and explain their answers in front of the class. These students are deliberately chosen by the teacher since they have different strategies each other. Then the discussion will continue to the different amongst the strategies and why they use those strategies in solving the problem.

If there is no student who uses a visual model in solving problem, teacher will ask them to try it as a strategy that can be used in solving problem and as a justification for the answer.

# The fifth activity

- a. Activity: The Shouting Match
- b. Starting Points:

### Knowledge

- Students know the relationship amongst fractions, decimals, proportions.
- Students have experienced working with percentage problems.
- Students apply the use of percentage bar in solving problems.
- Students know some procedures that can be used in solving percentage problems.

## Skill

- Students demonstrate their ability solving percentage problem
- Students practice using some strategies in solving a percentage problem.

### Attitude

- Students show consideration using certain strategy in solving a percentage problem.
- c. Mathematical idea:
- Using percent to do relative comparison
- d. Learning goal:

### Knowledge

- Students understand the relative nature of percent
- Students determine whether percents can be used in a decision-making situation or not
- Students understand that fractions, ratios, and percents as comparison tool

### Attitude

- Students show consideration in a decision-making situation.
- e. Classroom activity:

Students work with their worksheet and discuss in their group.

# Problem :

Two football clubs, Persebaya Surabaya and Sriwijaya FC, were competing in a football match. After the game, the coach of Persebaya Surabaya said, "We had a greater percentage of fans in the stands this time compared to the last game."

"No, I don't think so," replied the striker of Persebaya Surabaya. "I think they just made more noise this time because we were winning."

Decide whether the coach or striker was correct.

On the previous game, there were 1,200 spectators with 540 of Persebaya Fans. Today, there are 600 people of Persebaya Fans where the total spectators are 1,600.

f. Conjecture of students' thinking

### Problem

Students compare the percents of Persebaya fans at two different games using the given numbers. Some students will compare it using fractions instead of using percentage bar. Other students will use decimals in solving problems. Some students may use the "one percent strategy" in which they take one percent of the total and multiply that number to get the result. Other students will try to solve it using ratio or proportions.

g. Classroom discussion

Students make poster of their answer using a large paper. After that, students stick their poster in front of the class. Each group explains their answer in front of the class. The other students will give comments and discuss together the strategies that students use, the model, if they use a model, the answer, and etc.

### The sixth activity

- a. Activity: Own Production Activity
- b. Starting Points:

### Knowledge

- Students have experienced working with percentage problem.
- Students have already known the percentage bar.
- Students understand the relative nature of percent

## Skill

- Students determine that fractions, ratios, and percents are used as comparison tools.
- Students are able to use percentage bar as a model in solving percentage problem.

### Attitude

- Students show consideration using certain strategies in solving percentage problem.
- c. Mathematical idea:
- Procedures that can be used in solving a percentage problem

### d. Learning goal:

### Knowledge

- Students formulate the general rule of a certain strategy in solving percentage problems
- Students apply the strategy in solving a percentage problem

### Skill

- Students demonstrate their ability to make a general rule of a certain strategy
- Students use the strategy in solving percentage problems

### Attitude

- Students express their point of view in making the general rule of certain strategy.
- e. Classroom activity:

Students are asked to write down the general rule of a certain strategy. They suggest giving an example of a percentage problem and using that strategy in solving that problem. If students are not able to make the general rule, they are suggested to start with an example of percentage problem by their own. After that, they can use the strategy that they understand to answer the problem.

### f. Conjecture of students thinking

Some students will use fractions as a general rule. Other students will use decimals. Some students probably will make a general rule of ratios or proportions in solving percentage problem.

Students will make the percentage bar as a tool to help in solving problem. Students will come to the 1% procedure in solving the problem.

g. Classroom discussion

Teacher asks some students with different general rules of strategies to show their friends in front of the class. Students then will see some strategies that they can use to solve percentage problems. They will discuss the rules how can apply that strategy. This activity is a reflection of the five lessons before. It aims at checking whether they understand the lessons or not.



#### **CHAPTER V**

#### **RETROSPECTIVE ANALYSIS**

In this chapter, the retrospective analysis of data collected from pre-test, the preliminary experiment, the teaching experiment activities, and post-test are described. The result of this study is the underlying principles explaining how and why this design works. The hypothetical learning trajectory served as a guideline in the analysis to investigate and explain students' thinking in learning percentages.

### 5.1 Preliminary teaching experiment

#### 5.1.1 Pre-test

The pre-test consisted of 8 problems (see Appendix). Each problem has its own insight that students should gain in learning percentages.

Problem 1: It was aimed to see whether students understand the 100 percent is the total. Two out of five students answered the problem correctly. The other students convert the percentage given into the simplest fraction. Even they did not answer the problem correctly, the simplest fraction that they made was correct. It proved that they used to work with this kind of procedure.

Problem 2: It was aimed to assess whether students are able to construct visual model of percent. No one made the correct visualization of the problem. There were three students who could represent the 25 percent in their own way.

Problem 3: It was aimed to know whether students know that percentage is always related to something. This is the basic knowledge that students have to achieve in learning percentages but in fact no one can answer it.

Problem 4: It was aimed to see how students transform the fraction form to the percentage form using context. They were given the fraction and asked to change it into percentage form.

This was not a problem for them since all of them can answer it correctly. Some students multiplied it with 100 percent and the others multiplied it with a number in which can make the denominator into 100.

Problem 5: It was aimed to know students' strategy in solving percentage problem. The idea of this problem was about the part-whole relationship. There was only one student who could answer this problem correctly. He used the formal way as he did in the previous number.

Problem 6: It was aimed to know students ability to transform percent form into fraction form. All students can answer this problem correctly.

Problem 7: It was aimed to know students' strategy in finding the whole when the part is given. There was no student can answer this problem correctly. Some of the just left it out, some of them tried to do some calculation but did not come to the right answer.

Problem 8: It was aimed to know how students can compare two things relatively and what strategies they use to solve it. In fact, no one can answer this problem correctly.

Generally, only 5 problems out of 8 that can be solved by the students and form the 5 problems, only 2 problems that can be answered correctly by all students. If we focus to the sort of problems, the two problems that students can solved correctly were the problems that they usually did from their text book. Fractions were given and students were asked to make it into percentage forms. This is the reason why no hesitation showed when the students were interviewed about their answers. Not all students knew and understood that 100 percent is the total. It proved by their answer in the first problem. Since most problems were the story problem, it needed time to be understood before answering it. However, based on the results, students mostly only paid attention to the number stated in the problem. Using the numbers as information, some students tried to do operation such as multiplication or division.

5.1.2 Lesson 1

Activity: Exploring percentages.

In this activity, students were asked to bring some products in which percentages stated on it. Since there were only 5 students who brought the products, researcher also provided some products for them. The students worked in group consisted of 2 and 3 students. They were asked to categorize the products based on their own group discussion and stick them on the big paper. These papers later on were hang up on the white board.

One group categorize the products into two parts, first the products that less then 50 percent and the second one with the products that exactly and more than 50 percent. The other group arranged the products from the small number into the larger number. However, they only focused on the number stated as percentages, not to the meaning of percentages itself.

The researcher led discussion amongst students. From the discussion, students were able to state some situations where percentage plays a role. They also can state the percentage form into the fraction form. The different numbers of percents were used to make it real. The difficulty then came when they were asked to see the different meaning of numbers stated on the products. The most products that involved in this activity were the discount ads. This was because students usually saw the percentages on the catalog in the supermarket. They did not have problem in understanding the meaning of percentages in this context.

For example, when they were asked what if the products 90 percent discount, what it means for the customer and the seller, they could give their reasoning. One student said that it means the customer gets the cheaper price and the seller will loss. They also discussed the highest discount that they ever had. One student ever bought a shirt with 50 percent discount. Another student said that he ever bought a T-shirt with 70 percent discount. Some students looked confused when they tried to get the meaning of percentages in oil production pie chart. One student said that each color on the chart represent the percent. The larger area for one color, the greater numbers of percent stated for it. Mostly what has already predicted before appeared when the activity held. What students did even the way they categorized the products suit with the HLT designed.

#### 5.1.3 Lesson 2

In making sense of percent, 5 problems were posed (see Appendix). The contexts that were used here were mostly the discount contexts. Students were divided into 2 groups and asked to solve the problems in their groups. The interesting part in answering the problem was no problems that both groups cannot solve. So when one group cannot give the correct answer, the other gave explanation how to solve it. It continued until all problems finished. Some students can show their reasoning why can come to such an answer.

There were two problems that can be solved correctly by groups, the second and the third. The reason probably was because these kinds of problems had already been discussed in the first meeting. '40 percent is not the best offer', Faiz said '50 percent is better than 40 percent since 50 percent is the half of the price'. From his statements, Faiz seemed to have meaning of percentages in discount context. He also can relate the percentage with the fraction form. In solving percentage problem that posed in the fourth problem, students used the formal way. They changed the percent into fraction form and then multiplied it with the first price.

They were sure that the price that should be paid was equal to the first price minus percent discount of its price.

The answers that came from the students were not different from the conjecture that have been made.

### 5.1.4 Lesson 3

This was the first activity where students were asked to visualize the percentage. They were given a chance to make their own figure or shape to visualize the percent they have known. This activity did not only acquire the ability to draw, but also the ability to correspond the shading area with the percent which was intended for. It was also aimed to develop students'

sense of part-whole relationship. Moreover, form this activity; researcher can see the benchmark percents that emerged from the students.

Most students can estimate the shading area with the percent stated. They made some sort of shapes, for example rectangle, circle, and some irregular shapes. One student, namely Barka drew figures which were really hard to be understood. It was not clear how he could draw the area of 70 percent is smaller than the area of 30 percent. He looked struggle to nail it. He often asked to his friend how to make it. When he was encouraged to make his own, he draw the irregular shape and stated the percent and the shading area which was not correspond each other. He shaded more than a half of the figure and stated it as 25 percent.

Barka seemed to had not had the understanding of percentage and the part-whole relationship yet. However, he had basic understanding that his figure and percentage he made was not more than 100 percent. Together, students had discussion and showed their own figure to their friends. Sometimes they had argument of the percent stated and the area shaded which did not really fit and correspond each other.

What Barka did in this activity seemed like what had been predicted before. Students will find hard to visualize the percent since they cannot do right with the problem in the pre test. Since they were given a chance to make their own figure and stated their own percent, students came with the benchmark numbers of percent, for example 10 percent, 25 percent, 50 percent.

#### 5.1.5 Lesson 4

In this activity, two building were become context and students were asked to do some calculation to get the answer. With different whole, they were asked the same part. What was aimed to grasp by conducting this activity was students could applied the model namely percentage bar in solving the problem. At the beginning, researcher introduced the percentage bar to students.

Two students, namely Faiz and Rio used the formal way to answer the problem. Even though they came to the right answer, they were hard to explicate the meaning of percentage in the problem. Rio tried to draw the figure but it was only until he got some benchmark of percents, 10 percent, 25 percent, and 50 percent. He could not find 35 percent on the bar. Dino and Barka cannot solve the problem. Dino and Barka were asked to make the drawing of the percent and tried to use the percentage bar. Albeit they had not arrived to the percent asked, they could come to some benchmark percents. The other student, namely Avi could apply the percentage bar and come to the answer. He drew the figure and shaded the area as the percent asked. He also could correspond the percent and the shaded area.

From what Rio did, he has not understood how to use the percentage bar as a calculating tool yet he seemed to use the bar as reasoning tool. Meanwhile Barka and Dino were trying to work with percentage bar. Avi, the only student who used the percentage bar, was sure about his result. At this point, Avi had already used the percentage bar as a tool for reasoning and also as a tool for calculating. Avi also developed his understanding about part-whole relationship.

What students did in this activity were not out of the prediction. The next step for Barka and Dino was they needed more time to practice with the percentage bar. Faiz and Rio later were encouraged to check the result using the bar so that they can make sure the answer they had. Avi had found the better way in solving the problem had to practice using the percentage bar.

5.1.6 Lesson 5

Percent is also the way to represent the comparison. In this lesson, the problem was pose to the students was about the comparing activity. The main aimed was students could compare relatively and using the percentage as a way for comparing.

In the process, Avi preferred to use percent to compare relatively. He used the percentage bar as a model. Faiz, in this activity also use the percentage bar since he was stuck to find the

answer. He was promoted to do that. He made a good estimation of the percent asked. The interesting thing was he shade the area in which he thought as the area that corresponds with percent. There was no student who used the formal way to solve the problem. The other students still struggled using the percentage bar in solving the problem.

Without promoting to do it in percent and using the percentage bar, Avi could some to the answer. It means that for Avi the model was really helpful. Moreover, he applied it in solving some sort of problems, the building context in the lesson 4 and the comparing activity in lesson 5. The used of contexts in these problems also can give meaning for Avi in reasoning the meaning of percentages.

5.1.7 Lesson 6

The last activity was designed as a conclusion for the whole activities. Students were asked to make steps to solve percentage problem and applied it in the problem that they made by themselves.

Even though in the lesson, all problems provided in context, they made kind of problem that asked different form from the percentage form into fraction form. They also used the formal way in solving it. Avi, Faiz, and Rio made the story problem with the contexts in it. Avi and Faiz worked with the discount contexts, where Faiz asked the whole and Avi asked the part one.

Again in this part, we could see that Dino and Akbar engaged with their text book problem. Avi in this activity used the percentage bar in solving his own problem. Avi here seemed to have his general rule in solving problem.

5.1.8 Post-test

Problem 1: All students can answer this problem correctly. They had different reason how they could solve the problem.

Problem 2: Almost all students could give the representation of the problems.

Problem 3: To students could answer this problem in their own reason. They found something strange with the problems since there was no information about the total problems that was discussed. It is important they said, since they have to take it into account. This is what the problem aimed to make students aware about the characteristic of percent.

Problem 4: No problem was found in solving this kind of problem, since it happened in the pre test problem. Students were used to do this kind of problem based on their text book.

Problem 5: Two students who successfully answered this problem. One student used the percentage bar and the other one used trial and error. For student who could use the bar and got the answer, he could apply the bar as calculating tool and reasoning tool. It has been proved by the interview section which was held with him. When he was asked to do a percentage problem, he used the bar to come to the answer.

Problem 6: As a predicted before, there will be no problem in this kind of problem since students were used to do this kind of problem. They had already showed the formal way to calculate and transformed fractions into percents and vice versa.

Problem 7: Part whole relationship problem with context was the most difficult for the students. Avi, the one who could apply the bar in solving percentage problem was needed guidance in solving the problem. He needed help to distinguish the part and the whole of the problem. Finally, he came to the right answer.

Problem 8: Two students really worked with this problem and could come to the right answer. Both of them used the percentage bar as a tool for calculating and reasoning.

5.1.9 Conclusion of the preliminary teaching experiment

Based on our observation in the preliminary teaching experiment, conclusions can be drawn as following. In the first activity students showed their ability to categorize the products in different ways. They found that the use of percent was abundant in discount contexts. Activity two also made students aware about some problems that usually found in daily life. In other activities, their ability to visualize percent was developed. Avi developed his understanding of model in solving percentage problem, and he applied this model in some activities. While Barka and Dino were developing this model since they cannot solve the percentage problem using the formal way. Faiz in another way has attained the formal way in solving percentage problem. But when he was stuck with a problem that cannot be solve by his strategy, he used the percentage bar.

In the post test, the number of students that can solve the problems increase. All problems can be answered at this time. Even though no student could answer all problems correctly, they showed greater progress from the first time they worked with the problem.

### 5.2 Improvement of hypothetical learning trajectory

Since researcher will work with more students in the teaching experiment, the first activity should have to be rethought. Students will work with the percentages products, and since there will be 37 students involved, classroom management should be the priority.

The second activity which consisted of five problems probably need to be reduced. It spent a lot of time when students were asked to do the five problems in one meeting. There would not be enough time to held classroom discussion. Three problems that will be used are the budget trouble, the personal radio discount, and the price war. The other problems will be the homework for students and these will be discussed in the next meeting.

In activity three, students needed more time to work with different figures. It was aimed to make them realize the best shape to visualize the percentage as the main starting point of using percentage bar. The worksheet will be added, so that students could work with different kind of shapes. Probably, it was not given as the main activity but as the enrichment activity which students can do that at home. This is also to make them sure and realize by themselves

the best shape to visualize the percentage. The homework will be discussed in the beginning of the next lesson.

In activity four, the introduction percentage bar should be the main focus. Students who had already practiced with some sort of shaped will be guided to find the best figure to represent the percentage. It needs more attention from students.

In activity five, there should be an introduction or an example of how to compare relatively since it was hard to make students realize the greater numbers with different basis.

The problem or question in the last activity had to be formulated. It needed more space for students to work by their own. It probably could be divided into three parts, namely the steps that students use to solve percentage problems, an example of percentage problem that they made by their own, and the application of the rule in solving an example.

### 5.3 Teaching experiment

In this section, the improved of HLT was compared with the students' actual learning process during the teaching experiment phase. The result of the retrospective analysis in this teaching experiment would be used to answer the research question.

### 5.3.1 Pre test

There were 37 students who participated in the pre test. Generally, students had difficulty to visualize the percent into the real objects. Problem 2 for example, which was asked students to make 25 percent of blue balls, had been solved by some students by shading 25 balls out of 100 balls. Percent should be taken into account of something; this characteristic was not found by the students, so that no one can give the reasoning. They just did calculation using some numbers given in this problem without knowing the meaning of it. Finding the whole problem was the hardest problem since no one can come to the right answer this time. They

seemed like did not understand what should be found from the problem and the concept of part whole relationship was not grasped by the students.

In thirty seven students that were tested, almost all of them could answer the text-book problem correctly. The text book problems here were the problems that they usually worked with, where the context was not provided here.

There was one student who could solve the comparison problem correctly, namely Paris. He used the fractions to compare which one is greater than the other one.

5.3.2 Lesson 1

In this lesson, students were asked to bring some products where percentages have role.

Activity: Percentages around us

All students demonstrated how to make categorization the use of percentages in certain ways by making poster. Students were divided into group consisted of four. All the products that they brought were sticker on the big paper. They were asked later to walk around to see other posters that have been made by other groups.



Figure 5.1. Students categorized the products

Figure 5.1 showed students in their groups working with some products which have percentage in each. On the right side was the example of the categorization of the products which was made of the focus group.



Figure 5.2. Students glued their posters on the wall

After making poster in their groups, all posters now had to be glued on the wall (see Figure 5.2). This was aimed for the other groups can see what their friends did and gave comment later at others' works.

Teacher then led the classroom discussion by asking some questions. The most products that students brought were food and drink package. This result was totally different from what happened in small group. It was because there were 37 students who participated in this lesson while in the small groups there were only 5 students. From students' answer, researcher can conclude that students did not have difficulty in attain the meaning of percentage in some contexts, for example discount contexts, tax, vitamin on a food or drink. Students also did not have a problem in changing the form of percent into fraction.

What was going on in the classroom had already been discussed between the teacher and researcher. The students' answers also had already been predicted. By doing the classroom discussion, researcher needed to find the informal knowledge of percentages that students have.

### 5.3.3 Lesson 2

In this lesson, students had three problems where they have to solve in group. The three problems were got after discussing with the teacher since students needed more time to held whole class discussion. The other 2 problems became homework for students and will discuss in the next meeting.

Activity: Making sense of percent.

The three problems were discussed were budget trouble, discount of personal radio, and the price war. In answering the budget trouble, most students in their group found the strange thing where the total percents did not 100. In focus group, however, they concluded that there was no problem with the budget. Their strategy was by adding up all the percentages given in fraction form and when they got the same result with what stated in the problem, they concluded as the correct one. In checking the truthfulness of statement in problem 2, students mostly used the formal way.

After they finished answering the second problem,

Researcher: Can you explain to me how you could come to the answer?
Dila : There is 25 percent discount in buying a radio. 25 percent is equal to a quarter.
Researcher: How can you get a quarter?
Dila : Divided by 25
Researcher: how can you write 25 percent?
Cintya : 25/100 can be simplified into a quarter by dividing
Researcher: And then?
Cintya : It multiplied by 80.000 to get 20.000. This number then subtracted from 80.000 so that it becomes 60.000.

There was a transcription of discussion in focus group in solving percentage problem. From the transcript we can see that students did the problem together and had already had sense of 25 percent. Since this is the benchmark number of percent, she (Cintya and Dila) could simplify the form into fraction form. Moreover, students also understood the meaning of percentages using this context.

In solving the problem, no model had been used. All the works had been finished using the formal way. Students knew what the discount meant and almost students understand the price if the items get discount. This is what we called understanding the meaning of context in learning percentages. What percentage meant here was clear for students.

Generally, students were not accustomed to work in group. They also were not familiar with the kind of problem since they usually had their text book and worked based on the problems there.

The strategies that students use in this activity were not different from what had already been predicted at the beginning. The formal way that students use in the discount of personal radio problem also suited with the conjecture. However, the strategy such as counting the percent given into fraction form was not fit with the conjecture. Another strategy also emerged from the students when they tried to solve the price at the war problem using the ratio. Although they came with the right proportion of two numbers, they could not conclude the result in a better way.

5.3.4 Lesson 3

In this lesson, students had given opportunity to construct a figure or a shape which can be used to visualize the percentage. This was the beginning of the use of model.

Activity: The audience

Students were asked to shade the area where the audience came. Almost students drew not only the part of the audience but also drew the stage or the performance.

Some students' works were presented here,



Figure 5.3. Student' worksheet (A)


Figure 5.4. Student's worksheet (B)

Figure 5.5. Student's worksheet (B)

In their worksheets, students were given a freedom to choose the percent that they aimed to show. This activity also encouraged students to be able to estimate the percent, and recognize the relationship between a fraction and a percent. Besides, the part-whole relationship developed by doing this activity.

In Figure 5.3, student showed more understanding about percentage. When he was asked to estimate the percent he stated by using figure, he made also the capacity of the room and the number of audience coming in each show. The important thing here is he did not made mistake in stating the percent he intended to with the number of audience he determined. In Figure 5.4, student did correctly the relation between the shading area and the percent stated. The shapes that she made also support her first step in constructing model of percentage. The last worksheet was made by the student in focus group. What she was thinking at that time was not clear. She made 125 percent and 250 percent as the percent for audience who came at the shows. The portion of the shape shaded also did not show the relationship with the percent she stated. What we can conclude from her is she did not understand the meaning of percentages. She did not know the total is 100 percent.

Furthermore, from this activity the feeling for magnitude of 25 percent, 50 percent, and 100 percent could be developed. In fact, benchmark percents came from some students who deliberately made the same percent that can be shown with the shading area of their figures. However, some students in focus group, one of them is Nadine, just only stated the percent and shaded the area without connecting with the whole.

What Nadin (student did in Figure 5.4) did in her figure was out of the prediction. Since on the two previous lessons the discussion of percentage was the main issue, the meaning of percentage should attain by the student. This problem probably happened since Nadin only knew the procedure of doing calculation but never be stressed at the meaning of percentages.

5.3.5 Lesson 4

In this lesson, researcher provides the same context as the lesson 3. It was the continuation of that lesson. The reason why it used the same context was to make student engage with the activity and found the relation between them.

Activity: Comparing two buildings.

In this activity, students were given a problem which involved two different building which have different number of seat. Students were asked to calculate the number of seat that had been used based on the percent given.

Before going to the problem, teacher and students made agreement about the shape that can be used to state the percent best. Since they all stated that the rectangle figure was the best shape to visualize the percent, it was generalized as the tool later in solving percentage problem. Then teacher introduced the use of percentage bar. However, in the practice, teacher gave the same percent with the activity that we designed for this problem. It made students tent to copy and apply this procedure in their worksheet. Students were asked to do this activity in the group and made a poster of their answer. Teacher added that they should make in many ways to find the answer so that in the posters that they made there were the formal way and also the use of percentage bar.



Figure 5.6. Students' posters

In Figure 5.6 (A) poster, there was only one percentage bar and some combination of 35 percent. The percent which involved and used in the bar were 5 percent, 10 percent, 25 percent, and 50 percent. In Figure 5.6 (B) percent, there were two percentage bars for each building and each percentage bar was one combination of the 35 percent. The percent that appeared in the bars were 25 percent, 10 percent and 15 percent.

From group A poster, students have already used the percentage bar as the calculating tool. If we focused on the bar that they made, they did not stated where the 35 percent was. They just tried to find the percents that can be combined to make 35 percent. In fact, they successfully could do that. There were 6 combinations to arrive at 35 percent.

It was quite different from group B, when one student, Fitra, who was asked how he could do that, here was his answer.

Researcher: How you could get 35 percent? Fitra : 15 per 100. 15 per 100 times 1200. it will be 180 For 20 percent. 20 per 100 times 1200. it will be 240. **35 percent** is 35 per 100 times 1200, it will be 420.

From this small conversation, there were some remarks about his understanding. First, he did not use the bar as the calculating tool. Different from the A worksheet, Fitra used the bar as the tool for reasoning. He can reason with the bar to show where we can write 35 percent, but he used the formal way to get the value of the percent asked. Second, he surely knows how to calculate in formal way. However, here, he did not strightly go to the 35 percent. He divided into two benchmark numbers of percent namely 15 percent and 20 percent.

In this activity, students learnt to use percentage bar throughout solving problems. Since this was the first time for students to use model in learning percentages, they had not used to do it yet. What they did was mostly using the bar as a tool for reasoning or using it as a tool for calculating. Some groups including the focus group have tried to apply the percentage bar as both tools.

What group A and Fitra did were actually out of the conjecture that have been made. It has been predicted that students will solve the problem in different ways; even it was the formal way and the combination that can be made from the benchmark percent on percentage bar. However, when we talked about the percentage bar, researcher predicted that the use as the calculating tool and reasoning tool can be attained by the students.

5.3.6 Lesson 5

In this lesson the ability of students in solving percentage problem was the main focus. It does not mean that they had to solve the problem with making percent, but considered using percent to do relative comparison. Since this lesson before last, students were promoted to grasp other ideas of learning percentages, such as understand the relative nature of percent, determine whether percents can be used in a decision making situation or not, and understand that fractions, percents as the comparison tool.

Activity: The shouting match

It was hard to make students think relatively when comparing two things. They mostly used the absolute way so that before they moved to the activity, teacher use another context to be compared. It was basketball context where two students had scores different with different chance of scores. It reminded students about the fractions that they can be compare. Teacher also showed them how to use the percentage bar to compare. These strategies, that teacher used gave impact how students solve the problem later. It can be seen from students' worksheet. In this activity, the focus group tried to solve the problem using the percentage bar, but they did not have enough time to finish it.

Figure 5.7. Students' worksheet (A)

The figure 5.7 (A) showed how students can compare two different numbers by using fractions. After making the numbers into fractions, they did cross multiplication. This was the common or usual strategy that had been taught already by the teacher in the classroom, when they were in the beginning of learning fractions.



Figure 5.8. Students' worksheet (B)

The Figure 5.8 (B) showed students worked with the percentage bar. They wanted to use percent to compare relatively. This was exactly the relative nature of percent. Even though they did not solve the problem precisely, only correct for the last day match, they practiced to make estimation of what percent stated for today match. They came to better conclusion in comparing the two.



Figure 5.9. Students' worksheet (C)

Figure 5.9 was the work of Fitra's group in solving the problem. They made two versions or two ways in solving this kind of problem. The first one like stated above the bar was the proportion of two numbers, in which they change into the per hundred fractions. The other way was the use of percentage bar. They got the correct result for both matches. The interesting thing of the bar was the shaded area that they made to show the area that exactly the percentage asked.

From the three figures (5.7, 5.8, and 5.9) if we focused one by one, the A worksheet where the students used fractions to compare was the simplest way to practice. However, there would be a problem for them to determine the part and the whole if they did not understand both. They tend to work with numbers and the fastest strategy. It also had a drawback since the numbers not always simple and needed thorough calculation. Worksheet B was the point where the percentage bar used. They have already succeeded using the benchmark numbers of percent to help them find the percent asked. The last worksheet showed the understanding of using a model. They used the percentage bar as a tool for reasoning and at the same time also used it as a tool for calculating.

The strategies that students posed in the worksheet had already been predicted before. Since the students were given chances to solve it in their own. However, the one percent strategy that was predicted did not appear during the lesson. It was probably because there was no introduction of using it.

5.3.7 Lesson 6

In this last lesson, students were asked to formulate the general rule of a certain strategy in solving percentage problem. Besides, they were also asked to apply the rule to solve the problem that they made.

Activity: Students' own production.

The activity was divided into three problems. The first was the steps that students used in solving percentage problems. The second was an example of percentage problem that made by the students. The last one was the solution of the example using the rule that they have made.

There were some sort of answers that came from students in explicating their general rile in solving percentage problems.

tetaskan langkah-tangkah yang kamu lakukan untuk menyelesaikan soal yang berkaitan dengan persen. diubah ke perahan biasa i bila bisa dipertecil dipertecil bila diubah ke perahan desimal = yang pembilang dibagi penyebut dan akan menjadi hasil desimal, bila diubah ke pecahan campuran = perahan biasanye harus besar yang pombelang dindingkan penyebut

Figure 5.10. Students' answer (A)

amu lakukan untuk menyelesaikan soal yang berkaltan dengar mengetahui ara gang diketahui dalam Soal Mengetahui ala gang ditanga pada Soal - Barulah kita Jawab dengan Mengertikan sodi Hu kan Seksama dan telifi - Dan terakhir Membuat kala" Jadi" untuk mongelahur hasic akhir dan kacimat akhir bosenta Jaluabangup

Figure 5.11. Students' answer (B)

From the Figure 5.10 and 5.11, we can see that student' answer A and B were different. A focused on the steps how to change the fractions, including proper and improper fractions, decimal forms into percent. Meanwhile the B focused on the generalization of the way he could solve the problem. Different from what was predicted in HLT, students not only answer it based on their experiences in learning percentages but also they made some kind of conclusion about how to solve mathematics story problem.

Below there are some percentage problems that made by the students using context. Some students made the story problem.

Dari Sgoji agah , sebanyat 1 500 000 20% digunatam untuk membayar sekolah Ani. Beropa gay ayah? Figure 5.12. Students' example (A) Berikan zontoh masalah yang berkaitan dengan persen untuk menjelaskan langkah-langkah yang telah kamu susun sebelumnya 1 Hasil gabah kering giling Searang Petani 5 kuintal Ketika digiling Susut 50%. Bargpa kilogram beras yang diperolen petani itu De Sebuah Minimarket menjual 60% barang gg Inder Barang 19 Inder Certabut dibary mentadi 2 Juile : Earny A. 50 % dan Barring B. 10% Berge Dontah making - Proving Entang to short 7

Figure 5.13. Students' example (B)

bondung dopat Merrivat 4000 Karrar, di 50% karror teldin tetisi, persona round thank person teris: 7 B Hota di badung dapat Memuat alooo karar, 65% karror telah terisi, berapa kamar yong below tensis ??

Figure 5.14. Students' example (C)

Figure 5.12, 5.13, and 5.14 showed that those students' examples showed the use of context in percentage problems. There were also some students who made more than one problem as examples (B). These examples were solved by students using their own strategies below.



Figure 5.15. Students' strategies (A)

D Diketahui . Hasil gabah karing giling severng telani 4 kartal ketika digiling sever 45 %. Ditanga - Baapa kilogram baas yang alleroleh Reform 140? Jawab = 1 kuintal = lookg = 5 kuintal= 500kg - 30 % dari Jookg - 50 × 100 - 200kg = JO % Jari Skuntal - RED kg Dody , becas going diperoleh Petani itu adalah THEP LO 250

Figure 5.16. Students' strategies (B1)

Diketation - Subuah Minimarket mengoal 60 % tarang gang Impor Barang Impor dibagi 2 - Barang A-10% dan Barang & mo Ditanja · Bearta Joniah Making - Making Barang? Jaluah 60% 60 · 60 · 100 · 3.5 - 3.4 A. = x 50 . = x 1 . = borang B: 5 × 10 : 51× 1 ; 16 bollong Jodi - Jenlahmaking ? barang addilah A - 3 karang dag B= 6 barang

Figure 5.17. Students' strategies (B2)



Figure 5.18. Students' strategies (C)

Students' strategies A (figure 5.17) were the answer of the students' example A, and so on. From the students' example that posed by the students in their worksheets, they could formulate the contextual problems and solved them. The answers that they gave in fact were correct and systematic way even though most of them use the formal way. The contexts that they used for example the percent of the salary used the reduced of rice weight, the rooms that had been booked, and the ordering activity in the market. It means that they gradually realize the meaning of percentages in some contexts. They also asked about the benchmark numbers of percents since those are not difficult to calculate and students were avoided mistakes in their calculations. The students mostly solved the problem using the formal way. When they asked about this, they it was what they had learnt from the text book. Moreover, there were some students who copied the problems from the text book. The students who answered the problem using the percentage bar were the students in the focus group. They used this bar since they asked to do that. In fact, they came to the answer using the bar.

However, students could not connect the questions asked to do since they worked with them separately. The first question for example which was aimed to see the general rule students passed in solving percentage problem was not successfully done. Some students made the general rule for solving mathematics problem; it was different from what I expected them to do. Probably, they should be given an example before they worked with the problems.

5.3.8 Post test

The result of the post test did not show better development of students thinking. However, from what they had done in their activities during the six lessons, it can be concluded that they had learnt something and this was the important thing after all.

The perspective of the students was not easy to change. In answering the first problem for example (see Appendix) they argued by saying that the greatest percent was 100. This was different from what is the meaning of percent itself. Moreover, only some students who applied the use of model namely percentage bar in solving problem and he was not from the focus group.

Almost students could not recognize the missing point in the problem 3, in which this was one of the characteristic of percentages. Fitra gave the example of the number of problems to conclude his answer. It means in this point he probably was aware that percent should be taking into account.

In the post test, students again showed their ability to transform the fraction into percent and vice versa. It has been proved by the two problems in the test. The part-whole relation

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concept was the most difficult thing for students to attain. Problem number 5, which was aimed to find the percent of the part given, can be answered only by some students. In interview section, Paris one of the focus group who came with 10 percent as the answer gave different answer form what was expected from him. He used the formal way to solve it, but it was not correct steps. When he was asked to use the percentage bar, he could do that and came to the answer. Fitra, who used the percentage bar in solving problem, had difficulty to answer the problem in interview section. But from his answer during the interview, he has already used the bar as the calculating tool and the reasoning tool. In the other words, he has

In the seventh problem, he also showed his ability to find the whole when the part was known. Indeed he needed more guidance and helps in solving that kind of problem, but finally he could pass it. The last problem when students were asked the higher tax of two restaurants, they could not compare it relatively. Even though they had already learnt about comparison in the fifth lesson, they did not apply it in this problem. The focus student, Paris who in the pre test came with the correct answer, at this time did not show the ability to solve it. In interview section, he admitted that he knew the ways but he needed more time to solve it, while the other students cannot compare it relatively.

#### **CHAPTER VI**

#### **CONCLUSION AND DICUSSION**

The aim of this study is to develop classroom activities that support students in learning percentages. The research question that is posed is: '*How can we support students*' *understanding in learning percentages*?'. This research question is divided into two sub questions, namely I divided into 2 sub research questions: (1) *how can contexts support students' understanding of the meaning of percentages*? (2) *How do students construct a model in developing their understanding in learning percentages*?. In this chapter, researcher answer the research question based on the retrospective analysis, and then reflect on some issues in this study and elaborate recommendation for further studies to improve the mathematics education in Indonesia.

#### 6.1 Conclusion

In the learning process, students did not have difficulty in attaining the meaning of percentage in some contexts, for example discount contexts, tax, vitamin on a food or drink, and the nutrition on food package. Students also showed ability in changing the form of percent into fraction.

In beginning of the lesson, no model that had been used in solving percentage problems. All the works had been finished using the formal way. Students knew what the discount meant and almost students understand how to get the paid price if the items got discount. This is what we called understanding the meaning of context in learning percentages. What percentage meant here was clear for students. Generally, students were not accustomed to work in group. They also were not familiar with the kind of context problems since they usually had their text book and worked based on the problems there.

The feeling for magnitude of 25 percent, 50 percent, and 100 percent or what we can called the benchmark numbers of percent could be developed. In fact, benchmark percents came from some students who deliberately connected the percent stated and the area shaded.

Students learnt to use percentage bar throughout solving problems. Since this was the first time for students to use model in learning percentages, they had not used to do it yet. What they did was mostly using the bar as a tool for reasoning or using it as a tool for calculating. However, some groups including the focus group had tried to apply the percentage bar as both tools.

There were some strategies that students used to solve comparison problem. Some students used fractions to compare. Other students used percent in solving comparing; they used the percentage bar to find the percent. They have already been succeeded using the benchmark numbers of percent to help them find the percent asked. They used the percentage bar as a tool for reasoning and at the same time also used it as a tool for calculating.

The students mostly solved the problem using the formal way. When they were asked about this, they said that it was what they had learnt from the text book. Moreover, in giving examples of percentage problem, there were some students who copied the problems from the text book. The students who answered the problem using the percentage bar were the students in the focus group. They used this bar since they asked to do that. In fact, they can come to the answer using the bar.

To answer the research question, we firstly answer the sub questions by looking at the sequence of students' learning. Then, we can conclude as an answer to the main question.

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In the learning activities, all the problems were designed using some contexts where the percentages usually play role. The situations that proposed here were the daily problems that experientially real for the students. It started from the first lesson when students were bringing to explore their informal knowledge about the use of percent in daily life. The meaning of percentages based on context support students in learning meaningfully. In discount context for example, students realize that discount means the price becomes cheaper. That was why in the end of finding the price, students subtracted the first price and the discount price to get to the real price that should be paid. This strategy works in the opposite way with the tax context. In the process, students can reason about the context which was provided in each activity.

However, knowing the meaning of percentages did not prove that students can find the strategy and solve the problem correctly. Indeed, the context helped students in reasoning but not help in calculating. Another concept of percentages plays role here. In the teaching and learning mathematics in the classroom, students usually worked with the problems in mathematical symbol. There were no contexts provided here. Students then tent to use formal way as long as they can get the fast and correct answer. They are not used to work with these problems. This is the reason why students could not directly come to the strategy in solving percentage problem after they understood the meaning of percentages in the contexts provided.

One answer to cope this problem was by providing a model where students can use not only as a calculating tool, but also as a reasoning tool. In this study, the construction of the percentage bar took place. The advantage of the bar is that it has "body" – area. This body part was the visualization of the percent that students usually shaded. This model has already been proved helped students in understanding the problems. Activity in lesson 4 and 5 were

example where this model emerged as a useful tool. Students made the visualization of the percent asked by using the bar and in the same time use the bar in finding the answer.

The bar gradually changes from a concrete context-connected representation to a more abstract representational model that moreover is going to function as an estimation model, and to model that guides the students in choosing the calculations that have to be made. In the process, percentages are written above the bar and the corresponding numbers below the bar, or the other way around. Some students had successfully used the bar in solving percentage problem. They had used the tool both as the calculating and reasoning tool.

#### 6.2 Reflection on the important issues

In conducting the study, the main focus was not only students' thinking process. How activities helped the students in understanding percentages, how the discussion help students in learning and how the role of the teacher in supporting students' learning were observed.

6.2.1 Realistic Mathematics Education (RME)

In designing the sequence of instructional activities, we based on some ideas of RME. The instructional activity that has been designed in this study was only a part of the longer series of learning trajectories in learning percentages. The application of the RME principles will not be finished in some lessons. In fact it needs months or even years to make them applicable.

There are some findings after conducting the study as follows. Exploring the informal knowledge by asking students to categorize some products that use percentages made students aware with some contexts where percentages play role. The students could understand the different meaning of percents in different contexts.

Constructing the model in learning percentages helped students to attain more understanding in learning. The visualization that they made to represent percent finished in agreement of

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using the rectangle, which is called the percentage bar. In the activity four and five, the use of the bar took place. Students were able to solve percentage problem using the bar. They can use it as a tool to get the answer and as a tool to reason it.

#### 6.2.2 Classroom discussion

Classroom discussion took the important role in learning. There were 37 students who also had many ideas or opinion in answering the percentage problems. Even though not all students participated in the discussion, generally students paid attention where the teacher of their friends presented in front of the class. In learning mathematics, however, it was not a socio mathematics norm where students have to share their ideas in front of the class. Students usually did the activity individually and after that collected the papers to be examined by the teacher in the end of the lesson.

The interesting part of the discussion was the time that all students came with the idea how to make a figure to visualize the percent intended. After trying to represent percents using some shapes, students then agreed that the best shape to represent the percent is the rectangle. This shape later on becomes a model in solving percentage problem.

6.2.3 The role of the teacher

In this study, the teacher who was involved had been teaching almost one year. This was the first time she taught in grade 5 of primary school. However, she had some experiences in teaching students on the mathematics courses. She is an open-minded person and likes to give solution or idea in learning process. She also has good understanding about the students who involved in this study.

During the teaching experiment, she has shown good performance in managing the classroom. She also encouraged students to do the activity well. However, there were some misunderstanding happened with her, so that the teaching learning process did not work as what expected. Probably, it was because we did not have enough talk before and the teacher

forgot what the agreement that has already made was. Another reason probably because this was also the first time she taught grade 5 students in large numbers.

#### 6.3 Discussion

There are some marks from another researcher that will be elaborated. First is how to formulate the better sentences in the problem? It is about the wordings in the sentences in percentage problems. Since it was made in English, we need to find the better words or sentences so that students could understand what the problem exactly asked. Second was about the introduction of the percentage bar. How to make it better, not solely given by the teacher? I realize myself that after all, I wonder more time to talk to the teacher so we can manage the learning process.

This study was conducted in the fifth grade of primary school in the second semester. The topic was related to the fractions topic that had already been given before it. Students then usually worked with the problems like stated in text book. Indeed, the problems were not contextual problems. When we started to give some contextual problems, students were confused to understand the question. I am thinking about the students' worksheets usually contain more contextual problems in teaching and learning mathematics.

The learning actually does not finish only in two cycles. The study revealed that even had been conducting the two cycles, there were some students' thinking that did not suit with the conjecture. Even though there was the improvement of the HLT after conducting the first cycle. More cycles were needed to get better trajectories.

### 6.4 Further studies

In this present study, researcher only focuses on the use of context and the construction of model, namely percentage bar in supporting students in learning percentages. Later research

could also study about other aspects that can support students in learning percentages, such as the use of double number line or ratio table as a model.

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# Appendix 1

# **Teacher Guide**

## Learning percentages in the grade five of primary school

### General introduction about the role of the teacher

According to Fosnot et al (2006) there are some aspects of teaching qualities that should be acquired by teacher to facilitate children in mathematizing during learning process. The following description elaborates those aspects and how it fits into my study.

1. Pedagogy

In the pedagogy aspects, teacher facilitates pupils' construction of knowledge. Teacher gives time and allows pupils for thinking after asking a question that requires deep thought rather than seek for a quick answer. Teacher promotes pupils to share their mathematical reasoning and encourages others to comment on it. Teacher also facilitates pupils in discussing mathematical ideas, strategies in solving problems.

2. The use of context

In this aspect, teacher adapts and modifies context as she works with different pupils who has different level of understanding. The conjectures that I design beforehand will give teacher a guideline how to adjust and modify the learning in the case of unexpected event.

3. Mathematical content

Teacher actively facilitates the development of pupils' mathematical constructions. It can be done by questioning and promoting the discussion around mathematical ideas and strategies. Teacher also uses a mathematical model as a bridge to enable pupil to shift from their initial level of mathematizing towards the more formal one. For example, in learning percentages, teacher encourages discussion from about some strategies in solving percentage problems. Teacher promotes the use of percentage bar to help pupils visualize the problems.

## Introduction

Hypothetical learning trajectory is proposed as a term to identify and describe relevant aspects associated with a mathematics lesson plan, including: A description of the pupils' mathematical goals, starting position (what pupils have already learn or their informal knowledge), the mathematical activities (including the tasks or problems, that pupils work on to achieve the goals), and a hypothetical path that describes the pupils' learning process.

Therefore, in this chapter I would like to describe the starting point of the pupils, the learning goals, activities that allow me to reach the goals and the conjectures of pupils' thinking in the HLT.

My departure point in this study is pupils' current knowledge and ability. Most pupils in grade 5 indeed are familiar with newspaper or television. Only by reading the newspaper or watching television to be reminded that percent is one of the most widely used mathematical concepts.

Besides the informal knowledge that pupils experience in daily life, the starting point of the knowledge that pupils have already had before learning percentages also have to be attained. Percents should be introduced only after pupils thoroughly understand fractions and decimals and have experience with ratios and proportions. As is true for decimals and fractions, percents express a relationship between two numbers. An error on such a fundamental idea suggests that pupils did not know that 100 is the comparison base for percent. This is what also affirmed by Reys et al (2007) and Van den Heuvel Panhuizen, (1996) that a key feature of percentage – which must be understood in order to have insight into this concept – is that a percentage is a relation between two numbers or magnitudes that is expressed by a special ratio, namely, 'so-many-out-of-the-hundred'.

This present research uses many daily life contexts such as discount, theater buildings, and some other contexts in which percentage plays an important role. As the starting point, this research designs an activity to assess informal knowledge of pupils on percentage. In Realistic Mathematics Education where teaching is built on the informal knowledge of the pupils, the teaching of percentage could start with assessing what the pupils already know about percentage (Van den Heuvel-Panhuizen, 1994). After that, to give pupils opportunity to explore the meaning of percentage, some contexts related to part whole relationship are elaborated.

In this HLT, there are several learning goals expected to be reached by the pupils during the series of lessons in three weeks period. To reach the goals formulated, we designed a sequence of instructional learning for percentages which consists of six activities, which are elaborated as follows.

### **General starting point**

In the Indonesian curriculum, five grade pupils of primary schools in the second semester have already learnt about fractions, decimals, and have already had experienced working with the ratio and proportion problems.

- Pupils start to learn about fractions from the second semester of grade three age 8-9. They
  learn about the simplest fraction unit fractions and start to make visualization of them.
  In the second semester of grade four ages 9-10, pupils continue their learning about
  fractions including more complex fractions and their visualizations. They also learn to do
  operation with fraction such as addition and subtraction operation.
- 2. Pupils have learnt about in the second semester of grade four. They learn decimal right after they learn about fractions and their operations.
- 3. Pupils have learnt to transform fraction into decimals and vice versa in the second semester of grade four. They have experienced solving some problems which includes fractions and decimals problems.
- 4. Pupils have experienced solving some problems-application problems of fraction and decimals which related to the ratio and proportions.

The topic about percentages is a new topic for them in the beginning of the second semester after they have learnt all those topics before.

## The first activity

- Activity:
   Percentage around us
- b. Pre knowledge:Pupils have ever heard the word "percent", and they have ever seen in daily life.
- Mathematical idea:
   Exploring the informal knowledge of percentages
- d. Learning goals:

Knowledge

Pupils recognize the use of percents in some situations.

Pupils identify and list some situations in daily life that use percentages.

Pupils recognize percent means so many out of a hundred.

Skill

Pupils demonstrate how to make a categorization of the use of percentages in certain ways by making poster.

Attitude

Pupils express their point of view of some situations which need the use of percentage and why it is needed.

Pupils appreciate their friends' works by giving comment.

e. Starting positions

Knowledge

Informal knowledge:

Pupils have seen some situations using percentages.

Formal knowledge:

Pupils have already learnt about fractions and decimals and have experience working with ratio and proportion.

Pupils have already learnt about basic operations in fractions and decimals, such as addition, subtractions, multiplications, and divisions.

Skills

Pupils are able to demonstrate their ability to do calculation using fractions and decimals.

Attitude

Pupils show consideration where they could use fractions or decimals in solving problems.

f. Materials:

Poster papers, glue or plank ban, products using percentages, markers.

g. Preparation:

Pupils are asked to bring many objects or products that easily could be found around them which contain the use of percents. They have to collect some advertisements or pictures from magazines or newspaper, or other things that contain information and represent the use of percentages. Then, they need to bring their findings at school at the first start of learning percentages. Another part that has to be prepared is that the teacher also prepares some ads or other things that show the use of percents.

h. Classroom organization:

Pupils will sit in groups which consist of 3-4 pupils in each.

- i. Classroom activity:
  - Explaining activity (10 minutes)
  - Making categorization and poster (20 minutes)

Pupils are asked to make categorization together in their group of the percentage product that they have already found.

Some examples of the use of percents in daily life that can be shown to the class as a part of discussion,



They are asked later to walk around to see other posters that have been made by other groups. By doing this activity, pupils will learn to appreciate others productions. They express their point of view of what their reason is making categorization in such a way and give comments about the others products.

Pupils perform the categorization by making a poster in a big paper. They probably stick those products in order thoroughly, or just stick only one product of each situation as an example.

j. Conjecture of pupils' thinking:

Pupils recognize the use of percentages in some situations and list those situations. For example on the back of plastic package of instant noodle or chocolate bag, on the bottle of jam or milk. Pupils categorize the situations in certain ways. The way is determined by their discussion in group. For example they will categorize the products based on the context what the products show about, or another group will decided to categorize based on the number of percents stated, less than 50 percent and more than 50%.

Pupils categorize their findings based on their discussion in their own group. Probably some groups will list it and categorize based on the contexts that used, based on the number – less than or larger than 50%, based on the model or representation of the percentage – using a figure, only numbers, and etc. For example the data of vote from the newspaper is presented by the use of pie chart which has some colors and each color stated the different number of percents, on the brochure of department store the discount only represented by number – 20%, 50%, and etc.

Pupils recognize some situations where the use of percentages play role. Later on, the discussion will lead to find out what situation is mostly abundant of the use of percentages. Pupils recognize that percents only related to discount. It will happen since probably there is no one in their groups brings other contexts or situations that represent the use of percents. If it is happened, teacher will let pupils do in their own

way and then later she will ask after the pupils stick their posters on the wall and walk around to see their friends' posters.

k. Class discussion (20 minutes):

After pupils walk around and try to find any similarities and differences between their posters and other posters, teacher holds whole class discussion. Teacher then asks pupils what kind of products that show the use of percent after sightseeing they have done. Here, teacher also asks pupils whether they know the meaning of the symbol "%".

Another informal knowledge that can be appeared from pupils is the use of percentages in the discount context. What about if the price is 90% discount, what it means for the customer and also for the seller. This kind of question aims to see whether pupils realize that percentage close to 100 means almost everything and percentage close to 0 means almost nothing. This also digs pupils' daily activity when they go with their parent to the supermarket and get discount as an informal knowledge that they have. The idea that will be attained from this activity is percent means so many out of hundred. Another starting points as the formal knowledge that have been attained by Pupils before joining this lesson is the use of fractions and decimals. They later will be asked the form of percents stated in fractions or decimals, and so on.

Pupils show consideration of why their groups make such a kind of categorization and express point of view to other pupils' work. They will give comments on their friends' work and compare it with their own work. Another respond will probably come by suggestions why this or that categorization is the best one.

In general, the discussion will lead into some points.

- the knowledge of situations (discounts, fats, oil productions, etc-depend on pupils' products)
- the knowledge of different numbers (10%, 50%, and etc). This is also related to the fractions or even decimals forms that can be shown by the percentage given.
- the different meaning of numbers (measuring numbers, quantities, etc)

Whole class discussion is intended to find out the informal knowledge of percentage that pupils have. This is the goal that would be attained by the teacher after conducting the first activity. What pupils have known about percentages and the context in which pupils are familiar with will be the next attention for teacher and researcher.

l. Reflection (15 minutes)

At the end of the lesson, teacher asks pupils what the most situations that is used percentages. It aims to make pupils aware about the importance of percentages in daily life. Moreover, teacher asks pupils the meaning of percentage in a certain situation. For example, in the discount situations, if there is stated 25%, what it means for the buyer and the seller? What about if the discount is 99% or 5%?

m. Assessment

Teacher collects the posters and conducts informal interview with some pupils who has interesting answer or question during the lesson.

## The second activity

a. Activity:

Making sense of percent

b. Starting point:

Knowledge

Pupils know the use of percent in daily life.

Pupils recognize percent means so many out of hundred

Attitude

Pupils can express their point of view of some situations which need the use of percentage and why it is needed

- c. Mathematical idea:
  - Percent means so-many-out-of-hundred
  - Percentage describes part whole relationship
  - Visual representation of percents, as in a pie chart
  - Positive and negative growth described by means of percent.
- d. Leaning goals:

## Knowledge

Pupils develop the meaning of percent as so many out of hundred in some situations Pupils understand the characteristics of percents, as follow

According to De Corte, E., Depaepe, F., 'T Eynde, P., & Vershaffel, L. (2005), There are some characteristics of percentages that should be discovered by solving appropriate tasks and problems.

- A percentage expresses a relation between two numbers or quantities by means of a ratio. Pupils need to aware that percentages are always related to something and have, therefore, no meaning without taking into account.
- Percentages describe a fixed situation representing how different kinds of substances are related to each other.
- The reduction of adding up of percentages has a non linear character

- Percentages can be used to describe two different types of situations. *Skills* 

- Pupils can determine percents given the whole and a part

Attitude

Pupils can express their point of view in answering the problems given.

e. Material:

Pupils' worksheets, pen, and posters of the problems.

f. Preparation:

Teacher prepares pupils' worksheet and the problems in a big poster in order to held classroom discussion

g. Classroom organization:

Pupils work individually and then after finishing their work, they discuss the solutions in pairs.

- h. Classroom activity:
  - Explaining activity (10 minutes)
  - Answering the problem (35 minutes)

These problems has been taken from the book "Per Sense" by Holt, Rinehart, and Winston (2003) and adapted into Indonesian contexts.

1. The twin discount

After finishing their purchases at the book store, twins Lyla and Lena taked about their books price. Lena said, "We both got a 10 percent discount, yet we did not get the same *rupiah* amount. I saved Rp 4000, and you save only Rp 1000." "Oh," Lyla said, "I can live with it"

Is it possible to get the same percent discount and not get the same amount of money? Explain your answer.

2. The Best Price Ever

A store advertised, "Best price ever! 40 percent discount on all items!"

Is it really the best price? The manager of the store say yes, but a customer says no.

Do you agree with the manager or the customer? Explain why.

3. Budget Trouble

The student council president was expaining his budget plan: "This pie represents the school budget: 50 percent of the money goes for books, 25 percent for lunch improvements, and 35 percent for the student council president"

"Wait!" said the treasurer. "That adds up to 110 percent!"



Dark blue: School budget

Blue: Lunch

Light blue: President

Is there a problem with the budget? Explain.

4. The Discount Personal Radio

Lina: "Win, look here. There is a 25 percent discount on this Rp 80.000 personal stereo. You know, it's the one I wanted to buy. I need only Rp 60.000 now." Win: "You need only Rp 60.000? That doesn't seem right to me" If you were Lina, how would you explain your answer to Win?

5. The Price War

Two shopkeepers are comparing their prices, Jamie's store sells a phone for Rp200.000. Mike's store sells the same phone for Rp400.000. Jamie says, "Your store price is 100 percent more expensive!"

"That's not true," says Mike. "Your store price is only 50 percent less." Who is right?

i. Conjecture of pupils' thinking: Problem 1 This problem deals with the relative nature of percent. Lena may have gotten a Rp40.000 pair of pants for Rp36.000, while Lyla may have purchase a Rp10.000 T-shirt for Rp9.000. Pupils do not have to find these amounts, but some may come up with them.

Answer: Yes, it is possible. A 10 percent discount on a higher-priced item represents a large *rupiah* amout saved than the *rupiah* amount saved with a 10 percent discout on a lower-priced item. The only instance in which a 10 percent discount represents the same *rupiah* amount saved is when both items have the same original price.

If pupils were able to understand this problem, I probbaly will ask following question:

Would it work the other way around? Can two people get the same amount of discount and not the same percent discount?

Answer: Yes. For example, suppose Lena buys an Rp800.000 tape. With a 50 percent discount, she saves Rp400.000. If Lyla buys a Rp1.000.000 tape with a 40 percent discount, she also saves rp400.000.

### Problem 2

This story emphasizes the relative nature of percent. It is possible that a 20 percent discount will result in a better bargain than a 40 percent discount depending on the base price of the item and various factors such as markup and product quality.

Answer will vary. Some pupils may agree with the manager, saying that it is very possible that a 40 percent discount allows for the best prices he has ever offered. Other pupils may agree with the customer, saying that the customer may have seen identical items on sale at a different store. Some pupils may say that stores offering a 40 percent discount do not have the lowest prices since stores offering a 100 percent discount would have even better price.

### Problem 3

Yes, there is a problem with the budget. The percents of the budget used for the three areas must add up to 100 percent. Some pupils might suggest allocationg 50 percent of the budget for books and 25 percent each for the luch imprvements and the student council (not just the president).

The key point implied in the story concerns the identification of 100 percent as the maximum. Find out how many pupils consider this concept to be self-evident.

In addition, considering the pie chart given, pupils probabaly relate it to the fraction or decimal forms. This is can be strategy to make justification of their answers.

### Problem 4

Explanation will vary. One possibility follows:

The original price of the stereo is Rp 80.000. It is on sale at a 25 percent discount. Some Pupils know that 25 percent equals one-quarter. One-quarter of Rp 80.000 is Rp 20.000. So, after subtracting Rp 20.000 from Rp 80.000 to find the sale price.

Some Pupils may use a different strategy here: determine the sale price as <sup>3</sup>/<sub>4</sub> of the regular price.

## Problem 5

This problem is an example of the relative nature of percent. Percents are only understanable when compared to some base value.

Answer: Both shopkeepers are right. Jamie is correct in saying that Mike's price of Rp400.000 is 100 percent higher than her price of Rp200.000. Mike is also correct in saying that Jamie's price of Rp200.000 is 50 percent less than his price of Rp400.000. The two statements are equivalent

j. Classroom discussion (20 minutes):

After discussing in pairs, some pupils are asked to represent their answers and give explanation. Other pupils are asked to give opinions or other strategies in solving it. The problems will be discussed together one by one. For example, for the first problem one pair of pupils will give their answer and follow by other pupils' responses. The maximum responses are three responses. Before they move to the next problems, teacher will ask pupils to conclude the result of the discussion of the first problem.

k. Reflection (5 minutes)

Teacher asks pupils what they learn about percentages based on the lesson today.

l. Assesment

Teacher collects pupils' worksheet and helds informal interview with some pupils who have interesting opinion or answer during the lesson.

## The third activity

a. Activity:

The audience

b. Starting Point:

Knowledge

- Pupils are familiar of some situations which included percent
- Pupils understand percents as so many out of hundred
- Pupils understand the characteristics of percent.

Skill

- Pupils are able to determine percent given the whole and a part *Attitude* 

- Pupils show consideration working with percents based on their characteristics
- c. Mathematical ideas:
  - Percent means so many out of hundred
  - Percentages describe part whole relationship.
  - Percents that are relatively easy to estimate are known as benchmark percents
- d. Learning goals:

Knowledge

- Pupils are able to estimate percents
- Pupils construct a visual model of percent
- Pupils recognize the relationship between a fraction and a percent.

Skill

- Pupils demonstrate their ability to make a visual model of percents.

- Pupils practice to make a visual model of percent in some shapes.

Attitude

- Pupils show consideration make a visual model of percent and determine the percent shown.
- e. Materials:

Pupils' worksheet, big papers (flip papers), markers with different colors, plank bans.

f. Preparation:

Teacher has prepared pupils' worksheet, flip papers, plank bans and some markers with different colors.

g. Classroom organization:

Pupils will work individually. After they finish doing this problem, they are asked to compare their work in duos. In duos they are asked to make their solution in a big paper using some different colors of markers. Their posters will be slicked on the white board when they explain their work to the other pupils.

- h. Classroom activity:
  - Explaining activity (10 minutes)
  - Solving problems (20 minutes)

Pupils work with their worksheet individually. After they finish their work, they are asked to discuss in duos.

Some pupils will share their works in front of the class while the other pupils give comments or share their opinion.

Problem:

There are some performances that are held every month. Shade in the audience section of the room based on your own figure to show what percent of the room you think will be used for each show

a. A pop concert

All audience in the hall will stand up, no chair provided for the audience.

b. A historical play

All audience have seats and no one will stand during the performance.

c. A circus show

There are seats provided and the audience will not allow to stand.

i. Conjecture of pupils' thinking

This context gives pupils the opportunity to make their knowledge visible in drawings. Pupils show what percent of the seating area of a theater they think would be filled for various events by shading in a section of the figure for each event.

Since no figure is provided here, pupils do their own production to determine what figure as a place for the audience section. They will come with the different shapes of figures.

Moreover, this problem contains most of the relevant things pupils should know about the key benchmark percents—percents that are relatively easy to estimate. Pupils should also get a feeling for the magnitude of 25 percent, 50 percent, and 100 percent. Some pupils probably will come to the fractions first and then transform them into percents forms. This is possible because the pupils have already learnt about fractions before. From this problem, pupils are asked to construct and use visual model of percent. This is an open ended problem in which pupils can use their informal knowledge and prior knowledge to estimate the amount of audience in the show room.

The answers will be vary. Probably, pupils will deal with the coordination between the shading area and percent. All of the responses will be accepted, as long as the shaded portion of the picture and the percent roughly correspond. For example, if one student likes historical plays, he or she may expect a large audience. Also, pupils may choose fractions that cannot be expressed using easy benchmark percents.

- j. Classroom discussion (30 minutes)
  - After pupils discuss in pairs their solution, some of them are asked to represent their answer in front of the class. Pupils give their reasons in answering the problems. Other pupils who have different shapes from the previous pupils will be asked to present their answer in front of the class and compare them. The other pupils are asked to give comments.
  - They will see correspond between the shaded area and the percentage given. The discussion will be led to the question what makes it is hard to determine the percent. It is probably because of the figures or the percentages.
  - For the practice, teacher provides other shapes of the audience section to make pupils confident with their answers. This activity will encourage them to conclude which the better shape for representing the percents is. This is the first introduction of the use of model in learning percentages.
- k. Reflection (10 minutes)

Teacher asks pupils what the better model for visualize the percentage and why. Teacher asks how pupils estimate the percent on the figure. Teacher allows pupils to give suggestion or opinion.

l. Assessment

Teacher collects pupils' worksheet and conducts informal interview with some pupils about the problems

## The fourth activity

This activity will be divided into two activities.

- a. Activity 1: The card game (15-20 minutes) Activity 2: Comparing two theaters
- b. Starting points:

Knowledge

- Pupils understand the part whole relationship
- Pupils know benchmarks' percents
- Pupils understand the relation between fractions, decimals, and percents
- Pupils can relate the benchmark of percents into a visual model.

Skill

- Pupils are able to draw a visual model of percents

Attitude

- Pupils show consideration what the better visual model to represent the percents is.

- c. Mathematical idea:
  - Relation between fractions and percents
  - Percentage bar as a model in solving percent problem
- d. Learning goals:

Knowledge

- Pupils develop a visual model of percent
- Pupils recognize the relationship between a fraction and a percent
- Pupils understand the percentage bar

Skill

- Pupils are able to use a visual model of percent to solve the percentage problems
- Pupils demonstrate their ability to make relationship between fractions, percents *Attitude*
- Pupils show consideration about the visual model that they will use in representing the percent and in solving the percentage problems.
- e. Materials:

Pupils' worksheet, papers

f. Preparation:

Teacher has prepared pupils' worksheet and some papers. The papers will be used to conduct the first activity, namely the Card Games. The second activity will use the pupils' worksheet.

g. Classroom organization:

In the first activity, pupils will make their own problems individually and play the game in pairs.

In the second activity, pupils will work in group of three or four.

h. Classroom activity:

First activity

- Explaning activity (5 minutes)
- Playing the games (15 mnutes)

Teacher distributes the papers to the pupils. Each pupil gets one paper. Pupils will be asked to write down the percentage or the fraction or the decimals on one side and the other form on the other side. For example if pupil in the first side writes down 25%, the other side she or he writes <sup>1</sup>/<sub>4</sub>

Two pupils randomly chosen by the teacher and are asked to play a game in front of the class as an example for the whole class. One pupil mentions what the number on his or her first side of paper and the other pupil tries to guess another form of the number given which is stated on the back side of his paper.

Later on, all pupils in the classroom try to play the game in duos. They can change their partner after their card has already been played. The teacher then asks some pupils what they have got from the games-the question and the answer they have given.

Second activity

- Explaining activity (5 minutes)
- Answering the problem (20 minutes)

Pupils work with their worksheet and discuss in their group.

Problem:

Swarna Dwipa Hotel has about 300 seats. It is rather small compared to the Balai Sudirman building, which can seat four times as many people. Last night both theaters had a 35 percent attendance rate. About how many people attended the events at each theater?

i. Conjecture of Pupils' thinking

Answer:

Pupils will use fractions in solving problem. Since 35 percent of 300 is 105, 105 people attended the event at the Taman Budaya Padang. Since 35 percent of 1200 is 420, 420 people attend the event at Balai Sudirman building.

Pupils will use decimals in solving problem. They convert first 35 percent into 0.35 and then multiply it by 300 to get 105 for Taman Budaya Padang. They do the same way with the Balai Sudirman building.

Pupils will make proportion in solving the problem. 35/100 = 105/300 for the Taman Budaya Padang. They get 105 as the result. And for Balai Sudirman building they get 420 as the result by making 35/100 = 420/1200.

Pupils will use benchmark percent in solving the problem. Since 35 percent is 10 percent plus 25 percent, they first find 10 percent of 300 and then find 25 percent of 300. After that, they add the two results. They do the same way with the Balai Sudirman building's attendance.

If in solving this problem, pupils face difficulty, teacher suggests them to make representation of the seats by using shaded area like what they have already learnt in the previous activity. Pupils are expected to use the visualization of the problem which leads to the better one, namely percentage bar.

j. Classroom discussion (20 minutes)

In the discussion part, some pupils are asked to give and explain their answers in front of the class. These pupils are deliberately chosen by the teacher since they have different strategies each other. Then the discussion will continue to the different amongst the strategies and why they use those strategies in solving the problem.

If there is no pupil who use a visual model in solving problem, teacher will ask them to try it as a strategy that can be used in solving problem and as a justification for the answer.

k. Reflection (5 minutes)

Teacher allows pupils to give opinion what strategies that can be used in solving percentage problems.

l. Assessment

Teacher collects pupils' worksheet and conducts informal interview with some pupils.

# The fifth activity

- a. Activity: The Shouting Match
- b. Starting Points: *Knowledge*

- Pupils know the relationship amongst fractions, decimals, proportions.
- Pupils have experienced working with percentage problems.
- Pupils apply the use of percentage bar in solving problems.

- Pupils know some procedures that can be used in solving percentage problems. *Skill* 

- Pupils demonstrate their ability solving percentage problem
- Pupils practice using some strategies in solving a percentage problem.

Attitude

- Pupils show consideration using certain strategy in solving a percentage problem.
- c. Mathematical idea:
  - Using percent to do relative comparison
- d. Learning goal:

Knowledge

- Pupils understand the relative nature of percent
- Pupils determine whether percents can be used in a decision-making situation or not
- Pupils understand that fractions, ratios, and percents as comparison tool

Attitude

Pupils show consideration in a decision-making situation.

e. Materials:

Pupils' worksheet

f. Preparation:

Teacher prepares pupils' worksheet.

g. Classroom organization:

Pupils will work in group of three or four.

h. Classroom activity:

Pupils work with their worksheet and discuss in their group.

- Explaning activity (10 minutes)
- Answering the problem (20 minutes)

Problem :

Two football clubs, Persebaya Surabaya and Sriwijaya FC, were competing in a football match. After the game, the coach of Persebaya Surabaya said, "We had a greater percentage of fans in the stands this time compared to the last game."

"No, I don't think so," replied the striker of Persebaya Surabaya. "I think they just made more noise this time because we were winning."

Decide whether the coach or striker was correct.

On the previous game, there were 1,350 spectators with 450 of Persebaya Fans. Today, there are 500 people of Persebaya Fans where the total spectators are 1,600.

i. Conjecture of pupils' thinking

Problem

Pupils compare the percents of Persebaya fans at two different games using the given numbers. Some pupils will compare it using fractions instead of using percentage bar. Other pupils will use decimals in solving problems. Some pupils may use the "one percent strategy" in which they take one percent of the total and multiply that number to get the result. Other pupils will try to solve it using ratio or proportions.

j. Classroom discussion (30 minutes)

Pupils make poster of their answer using a large paper. After that, pupils stick their poster in front of the class. Each group explains their answer in front of the class. The other pupils will give comments and discuss together the strategies that pupils use, the model, if they use a model, the answer, and etc.

k. Reflection (10 minutes)

Pupils are asked to give opinion about using percentage in doing relative comparison, and what other strategies that can be used in solving this problem.

l. Assessment

Teacher collect posters, pupils' worksheet, and does informal interview with some pupils.

## The sixth activity

a. Activity:

**Own Production Activity** 

b. Starting Points:

Knowledge

- Pupils have experienced working with percentage problem.
- Pupils have already known the percentage bar.
- Pupils understand the relative nature of percent

Skill

- Pupils determine that fractions, ratios, and percents are used as comparison tools.
- Pupils are able to use percentage bar as a model in solving percentage problem. *Attitude*
- Pupils show consideration using certain strategies in solving percentage problem.
- c. Mathematical idea:
  - Procedures that can be used in solving a percentage problem

d. Learning goal:

Knowledge

- Pupils formulate the general rule of a certain strategy in solving percentage problems
- Pupils apply the strategy in solving a percentage problem

Skill

- Pupils demonstrate their ability to make a general rule of a certain strategy
- Pupils use the strategy in solving percentage problems

Attitude

Pupils express their point of view in making the general rule of certain strategy.

e. Materials:

Papers

f. Preparation:

Teacher prepares some papers for pupils

g. Classroom organization:
Pupils will work individually.

- h. Classroom activity:
  - Explaining activity (15 minutes)
  - Working with activity (20 minutes)

Pupils are asked to write down the general rule of a certain strategy. They suggest giving an example of a percentage problem and using that strategy in solving that problem.

If pupils are not able to make the general rule, they are suggested to start with an example of percentage problem by their own. After that, they can use the strategy that they understand to answer the problem.

i. Conjecture of pupils thinking

Some pupils will use fractions as a general rule. Other pupils will use decimals. Some pupils probably will make a general rule of ratios or proportions in solving percentage problem.

Pupils will make the percentage bar as a tool to help in solving problem. Pupils will come to the 1% procedure in solving the problem.

j. Classroom discussion (30 minutes)

Teacher asks some pupils with different general rules of strategies to show their friends in front of the class. Pupils then will see some strategies that they can use to solve percentage problems. They will discuss the rules how can apply that strategy. This activity is a reflection of the five lessons before. It aims at checking whether they understand the lessons or not.

k. Reflection (5 minutes)

Pupils are asked to give opinion about the rule that they have already made during the lesson.

l. Assessment

Teacher collects pupils' works and does informal interview with some pupils

# The classroom observation scheme

- 1. Interaction
  - a. Vertical

How pupils interact with teacher and how teacher interact with pupils

b. Horizontal

How pupils interact amongst them.

- 2. Organization of the class
  - a. The seat for the pupilsWhere they sitWith whom, why
  - b. How pupils do their task

Individually or in pairs or in small groups – how many pupils in one group In their book or making poster or mentally or in a piece of paper Collect the task or check/discuss together

Use their own ideas or follow the examples or formulas given by teacher

3. Time management

How long teacher:

- a. Opening the lesson
  Recalling the material in the last meeting
  Discussing homework
- b. Closing the lesson
- c. Explaining the materials
- d. Giving the task
- e. Allocating the time to let pupils do their tasks
- f. Conducting group or classroom discussion
- g. Giving homework and giving instruction about the homework
- 4. Group discussion
  - a. How many pupils in one group
  - b. How it is going in the group is there a special task for each pupil, for example who will write on the paper, who will find the answer, and so on.
  - c. The leader of the group discussion
  - d. Who the most active in the group
- 5. Whole class discussion
  - a. Who participates the discussion
  - b. How many pupils
  - c. How teacher leads the discussion What teacher does?
- Socio norms and mathematical norms in the class (only situations that can be observed and this is will be continued on the interview session)
   What pupils have to do and do not allowed to do
- 7. Teaching and learning process

- a. How does teacher explain the lesson (using power point or white board or posters, or etc)
- b. How does teacher facilitate pupils in teaching learning process (give reinforcement or give guided questions)
- c. What strategies pupils use in solving problems Using a model or using a formal way

# The teacher's interview scheme

1. Teacher background

Can you tell me, how long have you been teaching in primary school? How long have you been teaching in grade five? What about last year, how the percentage topic was?

2. PMRI

When did you join the *Pendidikan Matematika Realistik Indonesi* (PMRI)? What is your opinion about PMRI approach? How does PMRI approach in the teaching learning process? What are the implementations of PMRI in the classroom so far?

Is the approach helpful?

What does the interesting part or advantage of doing PMRI approach? How do pupils understanding or reaction by doing PMRI approach?

3. Socio norms

In the class, what do pupils not allow to do?

4. Mathematical norms

What pupils have to do during the lesson?

(during teacher' explanation, group discussion, doing the task, whole class discussion)

5. Teaching learning process

How do you assess pupils' understanding?

(from the written test, homework, tasks, and participations)

What is pupils' difficulty in learning mathematics?

How was the percentage lesson last year (the difficulty and how in general pupils solve percentage problems)?

Is there any model as a tool in helping pupils in learning mathematics?

6. Pupils background

How is pupils' level of understanding in this class?

Can you give explanation about the heterogeniousity in the classroom? Are there any pupils who take additional classes or mathematics course?

Attention!

Before you turn back your paper to the next page, read carefully the instruction below:

- 1. These papers consist of some percentages problems. Read carefully the question and try to solve it individually
- 2. The problems are intended to know how far you know about percentage topic
- 3. Your answers do not relate to your mathematics score in the class, so do not hesitate to show your thoughts
- 4. Do not use calculator or any tools in solving the problem
- 5. If you do not understand the question, try to guess it and solve it using your own way and give your explanations.
- 6. Use the space on the each number to write down your thoughts-anything you have in mind about the problem.
- 7. If you do not know the answer, try to guess it and write down your thoughts in the space

Believe in yourself and Good Luck



This jersey is made of Cotton and Polyester. What percentage of cotton should it say?

62% Polyester ..... Cotton

This problem aims to know whether pupils have a sense of percentage. It is related to the 100% is the total.



Make the drawing to express the situation below:
 25 percent of balls are blue

This problem aims to assess whether students are able to construct visual model of percent



3. In order to pass the exam, students have to do at least fifty percent of the problems correctly. Doni missed 10 problems. What do you think? Can we congratulate Doni or not? Explain your reasoning.

This problem aims to know whether pupils know that percentage is always related to something (amount or value).



4. 7/10 of books were given by government. What percentage is that? This problem aims to see how pupils transform the fraction form to the percentage form using context. 5. Didi wants to buy a hat. The hat costs Rp 30.000. Didi gets Rp 3000 off. What percentage reduction he get?

This problem aims to know pupils' strategy in solving percentage problems. The idea is about part-whole relationship



25% = .....

- .....
- 10% = .....

Write your ways on the box provided!

This problem aims to know pupils ability to transform percent form into fractions forms.

7. How much does this bag normally cost at Gramedia?

This problem aims to know pupils' strategies in finding the whole when the part is given. The idea is about part-whole relationship

# GRAMEDIA

This month

25% off

All kinds of bags of export products

NOW for only

Rp 60.000

8. There are two restaurants that offer new menu, but you have to pay tax for the food you order. If you order food for Rp40.000 in restaurant A you have to pay Rp8000 for the tax. If you order some food for Rp60.000 in restaurant you have to pay Rp9000 for the tax. Which restaurant has the higher tax? Give reason for your answer.

This problem aims to know how pupils can compare two things relatively and what strategies they use in solving it



# Perhatian

Sebelum lanjut halaman berikutnya, bacalah terlebih dahulu beberapa petunjuk di bawah ini,

- 1. Berikut akan disajikan beberapa soal yang berkaitan dengan persen.
- 2. Tulislah nama dan tanggal dalam kotak yang tersedia.
- 3. Bacalah soal-soal tersebut dengan teliti dan cobalah menyelesaikannya sendiri.
- 4. Soal-soal ini disajikan untuk mengetahui sejauh mana pengetahuanmu tentang persen
- 5. Jawaban yang kamu berikan tidak berhubungan dengan nilai matematika di kelas.
- 6. Dilarang menggunakan kalkulator atau alat bantu hitung selama proses pengerjaan soal
- 7. Jika kamu tidak mengerti maksud soal, tanyakanlah kepada gurumu.
- 8. Usahakan tidak ada nomor yang kosong
- 9. Gunakan kotak yang tersedia pada setiap nomor sebagai tempat menuliskan jawaban dan menulis apa yang kamu pikirkan mengenai soal tersebut.
- 10. Jika kamu menghadapi kesulitan dalam menyelesaikan soal yang diberikan, cobalah menebak jawabannya dan sertakan alasan kamu memperoleh jawaban tersebut.

Percaya diri dan Selamat bekerja.. !!!

Nama:

Hari/Tanggal:

1. Bahan yang digunakan dalam pembuatan kaos Timnas sepak bola terbuat dari campuran katun dan poliester. Berapa persen katun yang diperlukan dalam pembuatan kaos sepak bola tersebut?



1

Buatlah gambar untuk menyatakan keadaan berikut,
 "25 persen dari sekumpulan bola berwarna biru"

3. Agar bisa lulus ujian, Andi harus bisa menjawab dengan benar 50 persen dari semua soal ujian. Ternyata, setelah diperiksa oleh Bu Guru, Andi menjawab salah 10 soal. Menurut pendapatmu, apakah Andi lulus ujian? Berikan penjelasan untuk mendukung jawabanmu.



- 4. Pemerintah memberikan  $\frac{7}{10}$  dari seluruh buku yang ada di sekolah. Berapa persenkah buku yang diberikan tersebut?
- 5. Conan ingin membeli topi baru. Harga sebuah topi adalah Rp30.000,00. Conan mendapatkan potongan senilai Rp3.000,00. Berapa persen potongan yang diperolehnya?

- 6. Isilah titik-titik berikut. Gunakan kotak yang tersedia untuk menuliskan cara yang kamu gunakan.

  - c.  $10\% = \frac{10\%}{10\%}$

7. Pada bulan Februari, Toko Buku Gramedia memberikan diskon khusus.



8. Untuk merayakan ulang tahun Fitri, ayah berencana mengajak seluruh anggota keluarga makan di restoran. Ada dua restoran yang menjadi pilihan Fitri dan ayahnya, yaitu *restoran Selamat* dan *restoran Sejahtera*.

Jika memesan makanan senilai Rp40.000,00 di restoran Selamat, ayah harus membayar pajak Rp8.000,00. Jika memesan makanan senilai Rp60.000,00 di restoran Sejahtera, ayah harus membayar pajak Rp9.000,00.

Restoran mana yang memiliki pajak lebih tinggi? Berikan alasanmu.



# Rencana Pelaksanaan Pembelajaran 1

Satuan Pendidikan	: SD Pusri Palembang
Kelas/Semester	: V/II
Mata Pelajaran	: Matematika
Jumlah Pertemuan	: 1 x pertemuan

## Standar Kompetensi

Standar Kompetensi: 5. Menggunakan pecahan dalam pemecahan masalah

## Kompetensi Dasar

5.1 Mengubah pecahan kebentuk persen dan desimal serta sebaliknya

## Indikator

- 1. Melihat berbagai produk dalam kehidupan sehari-hari yang menggunakan persen
- 2. Mengelompokkan penggunaan persen berdasarkan persamaan dan perbedaan yang mereka temukan.

## Tujuan Pembelajaran

- 1. Siswa mengenali penggunaan persen dalam berbagai situasi
- 2. Siswa dapat mengidentifikasi dan mendata situasi-situasi dalam kehidupan sehari-hari yang menggunakan persen
- 3. Siswa mulai mengenali persen sebagai per seratus.

# Alokasi Waktu: 2 jam pelajaran (@ 35 menit)

# Media/Alat dan Sumber Belajar

- 1. Kertas plano
- 2. Selotip
- 3. Produk-produk berupa selebaran, iklan, kemasan plastik, brosur yang memuat penggunaan persen
- 4. Spidol

# Pendekatan/Metode Pembelajaran

PMRI (Pendidikan Matematika Realistik Indonesia)

### Aktivitas

Persen dalam kehidupan kita

# Langkah-langkah Pembelajaran

1. Pendahuluan

- Guru memandu siswa untuk duduk berkelompok sebagaimana yang telah ditentukan.
- Guru meminta siswa mengeluarkan barang-barang yang memuat penggunaan persen di dalamnya, yang pada hari sebelumnya telah diminta untuk dibawa ke sekolah.
- Guru membagi kertas plano kepada tiap kelompok.

### 2. Inti

- a. Dalam kelompoknya, siswa diminta untuk mengelompokkan barang-barang yang mereka bawa. Pengelompokkan ini diserahkan sepenuhnya kepada tiap kelompok.
- b. Siswa diminta untuk merekatkan barang-barang yang telah mereka kelompokkan tersebut di atas kertas plano yang telah tersedia.
- c. Siswa diminta untuk menempelkan poster yang mereka buat di dinding kelas.
- d. Siswa diminta untuk melihat poster-poster yang telah dibuat oleh kelompok lain dan memperhatikan pengelompokkan yang mereka buat.
- e. Diskusi kelas berlangsung dipimpin oleh guru
- f. Guru mengajukan beberapa pertanyaan kepada seluruh siswa, diantaranya: produkproduk apa yang menggunakan persen, produk apa yang paling banyak menggunakan persen.
- g. Siswa dari tiap kelompok diminta untuk menjelaskan pengelompokkan yang mereka buat beserta alasannya.
- h. Siswa diminta untuk memberi komentar atas poster yang dibuat oleh kelompok lain.
- i. Siswa diminta memberi pendapat kelompok mana yang memiliki pengelompokan paling bagus dan alasannya.
- j. Guru kembali mengajukan pertanyaan-pertanyaan, diantaranya: apa yang siswa tahu tentang simbol %, dalam konteks diskon apa maksud diskon 90 persen dan apa bedanya dengan diskon 5 persen dan bagaimana dengan konteks pajak atau kadar gizi dari makanan.
- k. Siswa diminta meperhatikan beragam angka yang ditunjukkan oleh persen, seperti 10 persen, 50 persen, 60 persen, dan lainnya jika dinyatakan dalam bentuk pecahan atau desimal.
- 1. Siswa diminta untuk melihat konteks yang ada dan memperhatikan arti dari persen yang tertera pada produk itu.
- m. Guru mengajukan pertanyaan: mengapa produk-produk tersebut menggunakan persen?

#### 3. Penutup

- a. Guru kembali menanyakan kapan persen paling sering digunakan
- b. Guru meminta pendapat siswa tentang pajak 10 persen yang harus dibayarkan ketika membeli makan di restoran.

# Alternatif Penilaian

Penilaian proses dapat dilakukan guru dengan melakukan pengamatan terhadap kemampuan siswa menjelaskan pekerjaan kelompoknya, berdiskusi dengan teman, berargumentasi dalam proses diskusi kelas, dan menjawab pertanyaan guru. Penilaian dapat pula dilakukan guru berdasar pada keaktifan siswa dalam mengikuti kegiatan di kelas.

Palembang, April 2012 Peneliti

Guru Kelas 5E,

Admelia jayanti Adlu, S. Pd

Yenny Anggreini

Menyetujui, Kepala SD Pusri Palembang,

Meliana, A. Md

# Rencana Pelaksanaan Pembelajaran 2

Satuan Pendidikan	: SD Pusri Palembang
Kelas/Semester	: V/II
Mata Pelajaran	: Matematika
Jumlah Pertemuan	: 1 x pertemuan

# Standar Kompetensi

Standar Kompetensi: 5. Menggunakan pecahan dalam pemecahan masalah

## Kompetensi Dasar

5.1 Mengubah pecahan kebentuk persen dan desimal serta sebaliknya

## Indikator

- 3. Siswa melihat masalah-masalah yang berkaitan dengan persen.
- 4. Siswa menyelesaikan soal-soal yang berkaitan dengan persen menggunakan cara yang mereka miliki

## Tujuan Pembelajaran

- 4. Siswa mengembangkan pengetahuan yang mereka miliki persen sebagai per seratus (pecahan berpenyebut seratus)
- 5. Siswa memahami sifat-sifat persen
- 6. Siswa dapat menentukan nilai persen yang diberikan sebagai keseluruhan dan sebagian.

Alokasi Waktu: 2 jam pelajaran (@ 35 menit)

# Media/Alat dan Sumber Belajar

- 5. Beberapa soal yang berkaitan dengan persen
- 6. Spidol

# Pendekatan/Metode Pembelajaran

PMRI (Pendidikan Matematika Realistik Indonesia)

## Aktivitas

"making sense of persen"

# Langkah-langkah Pembelajaran

### 1. Pendahuluan

a. Guru mengingatkan kembali pelajaran minggu lalu, diantaranya:

beberapa situasi yang menggunakan persen, nlai persen yang tertera (10%, 50%, dan lain-lain), pecahan atau desimal yang bisa ditunjukkan oleh persen, makna dari tiap persen yang tertera (untuk menghitung jumlah barang, untuk menunjukkan kadar gizi, dan lain-lain)

### 2. Inti

- n. Dalam kelompok yang terdiri dari dua orang, siswa-siswa diminta untuk menyelesaikan soal-soal yang diberikan.
- o. Setelah kelima soal tersebut selesai, guru meminta siswa mendiskusikannya dengan kelompok awal (empat siswa tiap kelompok)
- p. Selanjutnya guru mengadakan diskusi kelas.
- q. Seorang siswa sebagai perwakilan kelompok, kedepan maju dan mulai mempresentasikan jawaban mereka. Siswa-siswa yang lain diminta untuk memperhatikan.
- r. Kemungkinan jawaban siswa:

Soal 1

- Siswa akan menjawab dengan memberikan harga untuk kedua barang yang dibeli Lila dan Lena. Lena membeli barang senilai Rp40.000,00 sehingga jika mendapatkan diskon 10 persen, maka dia akan membayar Rp36.000. Lila membeli barang dengan harga Rp10.000,00, dia harus membayar Rp9.000,00 jika mendapat diskon 10 persen. Jika jawaban ini muncul dari siswa, guru akan bertanya bagaimana dia memperoleh harga Rp40.000,00 dan Rp10.000,00. Guru juga bisa melanjutkan pertanyaan dengan bertanya bagaimana siswa memperoleh nilai dari 10 persen dari tiap harga barang yang dibeli (cara apa yang mereka gunakan).
- Siswa hanya akan menjawab, hal ini bisa terjadi. Alasannya karena diskon 10 persen yang diberikan untuk harga yang mahal, akan menyebabkan nilai diskon yang tinggi atau uang kembalian menjadi lebih banyak. Dengan kata lain, harga yang berbeda dengan diskon yang sama akan menyebabkan uang kembalian yang berbeda. Kembalian yang sama, akan dipeoleh jika nilai diskon yang sama untuk harga barang yang sama. *Jika siswa mampu menjawab pertanyaan dengan alasan tersebut, maka guru bisa melanjutkan dengan bertanya, apakah akan berlaku sebaliknya? Dapatkah dua orang yang berbelanja dengan mendapatkan potongan harga yang sama namun dengan persen diskon yang berbeda? Jika siswa mampu mendapatkan jawaban dari pertanyaan ini, guru bisa meminta siswa menjelaskan bagaimana cara mereka memperolehnya.*

Soal 2

Soal ini menekankan pada sifat relatif yang dimiliki persen. Hal ini memungkinkan jika diskon 20 persen menghasilkan penawaran yang lebih baik dibandingkan dengan diskon 40 persen tergantung dari harga awal barang dan beberapa faktor lain seperti kualitas barang. Jawaban akan bervariasi. Sebagian siswa akan setuju dengan manager, berkata bahwa 40 persen diskon adalah penawaran terbaik. Sebagian siswa yang lain akan setuju dengan konsumen, mengatakan bahwa konsumen bisa mendapatkan barang yang sama dengan diskon yang lebih tinggi di toko lain. Siswa-siswa yang lain akan mengatakan bahwa toko yang menawarkan diskon 40 persen tidak memberikan harga terendah karena harga yang lebih baik dapat diberikan oleh toko dengan diskon 100 persen. Mintalah siswa memberikan contoh dengan memberikan harga dari sebuah barang, dan bagaimana harganya jika mendapatkan diskon senilai 40 persen. Hal yang perlu diperhatikan di sini adalah, makna dari diskon 40 persen yang menjadi persoalan. Guru bisa menanyakan arti dari kata 'diskon' untuk mengecek seluruh siswa dapat memahami kata ini. Guru juga bisa menggali pengetahuan siswa tentang 40 persen diskon. Jika diskon yang diberikan 40 persen, maka berapa persen yang harus dibayar? Bagaimana memperoleh harga yang harus dibayarkan jika barang mendapat diskon?

Soal 3

• Siswa akan menjawab, bahwa ada permasalahan dalam perdanaan yang dirancang ketua OSIS. Jumlah pendanaan haruslah 100 persen. Jika siswa telah mampu memberikan alasan seperti ini, guru bisa meminta siswa untuk meperbaiki anggaran sesuai jawabannya (jumlahnya 100 persen). Guru juga bisa mengaitkan persoalan ini dengan menggunakan pecahan ataupun desimal.

Soal 4

• Jawaban siswa akan bervariasi. Guru menggali pengetahuan siswa bagaimana mereka mampu menyelesaikan persoalan tersebut. Cara-cara apa yang bisa mereka gunakan untuk mengecek jawaban yang ada.

Soal 5

• Soal ini merupakan salah satu sifat dari persen yang mana persen akan lebih dimengerti jika dibandingkan dengan suatu nilai. Jawaban yang benar adalah kedua pelayan toko tersebut benar. *Guru memancing siswa untuk memberikan penjelasan bagaimana mereka memperoleh jawabannya. Jika siswa menjawab bahwa hanya* 

salah satu pelayan toko yang benar, guru meminta siswa menunjukkan hasil pekerjaan mereka.

Dalam diskusi kelas ini, partisipasi dari seluruh siswa sangat diharapkan. Namun, tidak ditujukan pada jawaban serentak. Siswa diharapkan mampu memberikan penjelasan ataupun meberikan contoh atas apa yang mereka kerjakan. Soal-soal tersebut akan didiskusikan satu demi satu. Misalnya, untuk soal pertama, beberapa perwakilan kelompok memberikan jawaban mereka dan diikuti dengan pendapat atau pertanyaan dari kelompok lain. Maksimum penanya atau pemberi pendapat adalah 3 orang. Sebelum maju ke soal selanjutnya, siswa diminta untuk membuat kesimpulan dari soal yang pertama.

# 3. Penutup

c. Guru kembali menanyakan apa yang dipelajari siswa dengan menyelesaikan soal-soal yang diberikan.

# Alternatif Penilaian

Penilaian proses dapat dilakukan guru dengan melakukan pengamatan terhadap kemampuan siswa menjelaskan pekerjaan kelompoknya, berdiskusi dengan teman, berargumentasi dalam proses diskusi kelas, dan menjawab pertanyaan guru. Penilaian dapat pula dilakukan guru berdasar pada keaktifan siswa dalam mengikuti kegiatan di kelas.

Palembang, April 2012 Peneliti

Guru Kelas 5E,

Admelia jayanti Adlu, S. Pd

Yenny Anggreini

Menyetujui, Kepala SD Pusri Palembang,

Meliana, A. Md

# Rencana Pelaksanaan Pembelajaran 3

: SD Pusri Palembang
: V/II
: Matematika
: 1 x pertemuan

## Standar Kompetensi

Standar Kompetensi: 5. Menggunakan pecahan dalam pemecahan masalah

## Kompetensi Dasar

5.1 Mengubah pecahan kebentuk persen dan desimal serta sebaliknya

## Indikator

- 5. Siswa menampilkan nilai-nilai persen yang familiar atau lebih dikenal dengan 'benchmark' persen
- 6. Siswa membuat visualisasi dari nilai persen yang difikirkannya

## Tujuan Pembelajaran

- 7. Siswa mampu melakukan estimasi pada nilai persen tertentu
- 8. Siswa mulai membuat sebuah model visual dari persen
- 9. Siswa menyadari adanya hubungan antara persen dan pecahan.

Alokasi Waktu: 2 jam pelajaran (@ 35 menit)

# Media/Alat dan Sumber Belajar

- 7. Beberapa soal yang berkaitan dengan persen
- 8. Spidol

# Pendekatan/Metode Pembelajaran

PMRI (Pendidikan Matematika Realistik Indonesia)

### Aktivitas

Ruang penonton

# Langkah-langkah Pembelajaran

# 1. Pendahuluan

- b. Guru meminta siswa mengeluarkan pekerjaan rumah yang diberikan pada pertemuan sebelumnya.
- c. Guru meminta beberapa orang siswa menjelaskan jawaban yang mereka peroleh.
- d. Guru mengaitkan soal tersebut dengan soal-soal yang telah dibahas pada pertemuan sebelumnya.
- e. Guru dan siswa membuat kesimpulan tentang sola tersebut.

# 2. Inti

- s. Secara perorangan, siswa diminta untuk mengerjakan soal yang telah tersedia. Jawaban soal tersebut nantinya akan ditulis dalam kertas plano. Tiap siswa mendapat selembar kertas plano.
- t. Setelah selesai perorangan, guru meminta siswa berpasangan dan mendiskusikan hasil pekerjaan mereka.
- u. Beberapa orang siswa diminta maju ke depan dan menunjukkan hasil pekerjaan mereka, sementara siswa lain memberi tanggapan.
- v. Apapun gambar ruangan penonton yang mereka buat, diperkirakan bahwa siswa cenderung menggambar nilai persen yang mudah, seperti 25 ersen, 50 persen, 100 persen, dan lain-lain. *Yang perlu diperhatikan adalah beberapa hal sebagai berikut:* 
  - Gambar ruang duduk penonton yang dipilihnya untuk bisa merepresentasikan nilai persen.
  - Kesesuaian gambar yang diarsir dengan nilai persen yang diberikan. Guru bisa bertanya bagaimana siswa memperoleh nilai persen tersebut atau bagaimana dia bisa membuat gambar itu untuk mewakili persen yang ditentukannya.
  - Kaitan persen dengan pecahan yang bisa muncul melalui gambar tersebut.
- w. Setelah soal tersebut selesai dibahas, guru meberikan lembar kerja kedua. Pada lembar kerja ini yang terjadi adalah kebalikan dengan aktivitas sebelumnya, dimana pada aktivitas kedua ini siswa diberikan beberapa gambar bangun datar dan siswa diminta untuk mengarsir daerah sesuai dengan nilai persen yang mereka tentukan sendiri. Siswa bekerja sendiri-sendiri untuk menyelesaikan lembar kerja kedua ini
- x. Selanjutnya guru mengadakan kembali diskusi kelas.
- y. Beberapa orang siswa maju untuk menunjukkan hasil pekerjaan mereka dan memberikan penjelasan.
- z. Sama seperti halnya aktivitas pertama, guru juga diminta memperhatikan beberapa hal (lihat kembali poin d)
- aa.Dalam pelaksanaan diskusi ini, diharapkan siswa mampu menampilkan seluruh aspek yang mereka ketahui tentang persen. Selain itu diharapkan siswa mampu mengaitkan persen dengan pecahan yang telah dipelajari sebelumnya. Jenis pertanyaan yang seringkali muncul adalah: "bagaimana".

#### 3. Penutup

d. Dari latihan dengan beberapa bangun tersebut, guru menanyakan gambar bangun apa yang paling mudah digunakan untuk menggambarkan nilai dari persen dan meminta penjelasan siswa dari tiap jawaban yang mereka berikan.

# Alternatif Penilaian

Penilaian proses dapat dilakukan guru dengan melakukan pengamatan terhadap kemampuan siswa menjelaskan pekerjaannya, berdiskusi dengan teman, berargumentasi dalam proses diskusi kelas, dan menjawab pertanyaan guru. Penilaian dapat pula dilakukan guru berdasar pada keaktifan siswa dalam mengikuti kegiatan di kelas.

Guru Kelas 5E,

Admelia jayanti Adlu, S. Pd

Yenny Anggreini

Peneliti

Palembang, April 2012

Menyetujui, Kepala SD Pusri Palembang,

Meliana, A. Md

# Rencana Pelaksanaan Pembelajaran 4

Satuan Pendidikan	: SD Pusri Palembang
Kelas/Semester	: V/II
Mata Pelajaran	: Matematika
Jumlah Pertemuan	: 1 x pertemuan

## Standar Kompetensi

Standar Kompetensi: 5. Menggunakan pecahan dalam pemecahan masalah

#### Kompetensi Dasar

5.1 Mengubah pecahan kebentuk persen dan desimal serta sebaliknya

#### Indikator

- 7. Siswa memahami hubungan antara pecahan dan persen
- 8. Siswa membuat visualisasi atau model untuk menyelesaikan masalah persen yang dimilikinya.

## Tujuan Pembelajaran

- 10. Siswa mengembangkan model visual persen
- 11. Siswa menyadari hubungan antara pecahan dan persen
- 12. Siswa memahami penggunaan batang persen.

Alokasi Waktu: 2 jam pelajaran (@ 35 menit)

### Media/Alat dan Sumber Belajar

- 9. Karton kecil
- 10. Masalah yang berkaitan dengan persen
- 11. Spidol

#### Pendekatan/Metode Pembelajaran

PMRI (Pendidikan Matematika Realistik Indonesia)

## Aktivitas

Permainan kartu

Perbandingan dua gedung

### Langkah-langkah Pembelajaran

#### 1. Pendahuluan

f. Guru memberikan beberapa pertanyaan yang berkaitan dengan aktivitas sebelumnya. Misalkan, guru menggambar persegi panjang lalu mengarsir setengah bagian persegi dan bertanya pada siswa, berapa persenkah bagian yang diarsir?. Hal ini bisa dilanjutkan untuk 25 persen dan 100 persen.

#### 2. Inti

Permainan Kartu

- bb. Guru membagiakn dua lembar kartu berukuran kecil kepada tiap siswa
- cc.Guru meminta siswa untuk mengisi kartu tersebut pada kedua sisinya. Di satu sisi, siswa diminta menuliskan nilai persen yang difikirkannya dan di sisi yang lain, siswa diminta menuliskan nilai pecahan yang sesuai dengan persen tadi. Begitu seterusnya untuk kedua kartu.
- dd. Setelah selesai permainan kartu dimulai. Secara bergantian dua orang siswa saling menanyakan kartu yang mereka buat. *Misalkan seorang siswa membuat nilai 25 persen dan bertanya pada temannya, nyatakanlah dalam bentuk pecahan nilai persen tersebut. Temannya akan menjawab 25 per seratus. Jika yag dimaksudkan siswa adalah seperempat, maka jawaban temannya belum tepat dan diminta untuk mencari jawaban lain. Begitu seterusnya sampai pasangannya bisa menjawab dengan benar dan mereka bertukar tempat lagi sebagai penany dan penjawab soal.*
- ee.Setelah selesai, guru membagikan lembar aktivitas siswa.
- ff. Siswa diminta untuk menyelesaikan masalah tersebut dengan cara mereka sendiri.
- gg. Guru membimbing siswa dalam mengajarkan penggunaan "percentage bar"
- hh. Siswa diminta untuk mencoba menggunakan batang persen tersebut dalam menyelesaikan soal
- ii. Selanjutnya guru mengadakan kembali diskusi kelas.
- jj. Beberapa orang siswa maju untuk menunjukkan hasil pekerjaan mereka dan memberikan penjelasan.
- kk. Sama seperti halnya aktivitas pertama, guru juga diminta memperhatikan beberapa hal (lihat kembali poin d)
- II. Dalam pelaksanaan diskusi ini, diharapkan siswa mampu menampilkan seluruh aspek yang mereka ketahui tentang persen. Selain itu diharapkan siswa mampu mengaitkan persen dengan pecahan yang telah dipelajari sebelumnya. Jenis pertanyaan yang seringkali muncul adalah: "bagaimana".

#### 3. Penutup

e. Dari latihan dengan beberapa bangun tersebut, guru menanyakan gambar bangun apa yang paling mudah digunakan untuk menggambarkan nilai dari persen dan meminta penjelasan siswa dari tiap jawaban yang mereka berikan.

# **Alternatif Penilaian**

Penilaian proses dapat dilakukan guru dengan melakukan pengamatan terhadap kemampuan siswa menjelaskan pekerjaannya, berdiskusi dengan teman, berargumentasi dalam proses diskusi kelas, dan menjawab pertanyaan guru. Penilaian dapat pula dilakukan guru berdasar pada keaktifan siswa dalam mengikuti kegiatan di kelas.

Palembang, April 2012

Guru Kelas 5E,

Peneliti

Admelia jayanti Adlu, S. Pd

Yenny Anggreini

Menyetujui, Kepala SD Pusri Palembang,

Meliana, A. Md

# Rencana Pelaksanaan Pembelajaran 5

Satuan Pendidikan	: SD Pusri Palembang
Kelas/Semester	: V/II
Mata Pelajaran	: Matematika
Jumlah Pertemuan	: 1 x pertemuan

## Standar Kompetensi

Standar Kompetensi: 5. Menggunakan pecahan dalam pemecahan masalah

#### Kompetensi Dasar

5.1 Mengubah pecahan kebentuk persen dan desimal serta sebaliknya

#### Indikator

- 9. Siswa memahami hubungan antara pecahan dan persen
- 10. Siswa membuat visualisasi atau model untuk menyelesaikan masalah persen yang dimilikinya.

### Tujuan Pembelajaran

- 13. Siswa mengembangkan model visual persen
- 14. Siswa menyadari hubungan antara pecahan dan persen
- 15. Siswa memahami penggunaan batang persen.

Alokasi Waktu: 2 jam pelajaran (@ 35 menit)

### Media/Alat dan Sumber Belajar

- 12. Karton kecil
- 13. Masalah yang berkaitan dengan persen
- 14. Spidol

#### Pendekatan/Metode Pembelajaran

PMRI (Pendidikan Matematika Realistik Indonesia)

### Aktivitas

Permainan kartu

Perbandingan dua gedung

### Langkah-langkah Pembelajaran

#### 1. Pendahuluan

g. Guru memberikan beberapa pertanyaan yang berkaitan dengan aktivitas sebelumnya. Misalkan, guru menggambar persegi panjang lalu mengarsir setengah bagian persegi dan bertanya pada siswa, berapa persenkah bagian yang diarsir?. Hal ini bisa dilanjutkan untuk 25 persen dan 100 persen.

#### 2. Inti

#### Permainan Kartu

mm.Guru membagiakn dua lembar kartu berukuran kecil kepada tiap siswa

- nn. Guru meminta siswa untuk mengisi kartu tersebut pada kedua sisinya. Di satu sisi, siswa diminta menuliskan nilai persen yang difikirkannya dan di sisi yang lain, siswa diminta menuliskan nilai pecahan yang sesuai dengan persen tadi. Begitu seterusnya untuk kedua kartu.
- oo. Setelah selesai permainan kartu dimulai. Secara bergantian dua orang siswa saling menanyakan kartu yang mereka buat. *Misalkan seorang siswa membuat nilai 25 persen dan bertanya pada temannya, nyatakanlah dalam bentuk pecahan nilai persen tersebut. Temannya akan menjawab 25 per seratus. Jika yag dimaksudkan siswa adalah seperempat, maka jawaban temannya belum tepat dan diminta untuk mencari jawaban lain. Begitu seterusnya sampai pasangannya bisa menjawab dengan benar dan mereka bertukar tempat lagi sebagai penany dan penjawab soal.*
- pp. Setelah selesai, guru membagikan lembar aktivitas siswa.
- qq. Siswa diminta untuk menyelesaikan masalah tersebut dengan cara mereka sendiri.
- rr. Guru membimbing siswa dalam mengajarkan penggunaan "percentage bar"
- ss. Siswa diminta untuk mencoba menggunakan batang persen tersebut dalam menyelesaikan soal
- tt. Selanjutnya guru mengadakan kembali diskusi kelas.
- uu. Beberapa orang siswa maju untuk menunjukkan hasil pekerjaan mereka dan memberikan penjelasan.
- vv. Sama seperti halnya aktivitas pertama, guru juga diminta memperhatikan beberapa hal (lihat kembali poin d)
- ww. Dalam pelaksanaan diskusi ini, diharapkan siswa mampu menampilkan seluruh aspek yang mereka ketahui tentang persen. Selain itu diharapkan siswa mampu mengaitkan persen dengan pecahan yang telah dipelajari sebelumnya. Jenis pertanyaan yang seringkali muncul adalah: "bagaimana".

#### 3. Penutup

f. Dari latihan dengan beberapa bangun tersebut, guru menanyakan gambar bangun apa yang paling mudah digunakan untuk menggambarkan nilai dari persen dan meminta penjelasan siswa dari tiap jawaban yang mereka berikan.

# **Alternatif Penilaian**

Penilaian proses dapat dilakukan guru dengan melakukan pengamatan terhadap kemampuan siswa menjelaskan pekerjaannya, berdiskusi dengan teman, berargumentasi dalam proses diskusi kelas, dan menjawab pertanyaan guru. Penilaian dapat pula dilakukan guru berdasar pada keaktifan siswa dalam mengikuti kegiatan di kelas.

Palembang, April 2012

Guru Kelas 5E,

Peneliti

Admelia jayanti Adlu, S. Pd

Yenny Anggreini

Menyetujui, Kepala SD Pusri Palembang,

Meliana, A. Md

# Rencana Pelaksanaan Pembelajaran 6

Satuan Pendidikan	: SD Pusri Palembang
Kelas/Semester	: V/II
Mata Pelajaran	: Matematika
Jumlah Pertemuan	: 1 x pertemuan

## Standar Kompetensi

Standar Kompetensi: 5. Menggunakan pecahan dalam pemecahan masalah

#### Kompetensi Dasar

5.1 Mengubah pecahan kebentuk persen dan desimal serta sebaliknya

#### Indikator

- 11. Siswa merancang masalah yang berkaitan dengan persen
- 12. Siswa menyelesaikan masalah yang berkaitan dengan persen menggunakan cara yang dipahaminya

## Tujuan Pembelajaran

- 16. Siswa mampu membuat aturan umum dari sebuah strategi dalam menyelesaikan masalah yang berkaitan dengan persen
- 17. Siswa mampu mengaplikasikan strategi yang dimilikinya dalam menyelesaikan masalah yang berkaitan dengan persen

Alokasi Waktu: 2 jam pelajaran (@ 35 menit)

### Media/Alat dan Sumber Belajar

15. Lembar kerja siswa

## Pendekatan/Metode Pembelajaran

PMRI (Pendidikan Matematika Realistik Indonesia)

### Aktivitas

Karya sendiri

# Langkah-langkah Pembelajaran

## 1. Pendahuluan

- h. Guru mengingatkan kembali tentang strategi yang bisa digunakan untuk menyelesaikan masalah yang berkaitan dengan persen.
- 2. Inti

Karya Sendiri

xx. Guru membagikan lembar kerja siswa. Di halaman pertama, siswa diminta untuk membuat langkah-langkah strategi yang digunakannya dalam menyelesaikan masalah yang berkaitan dengan persen.

Contoh jawaban siswa:

- Pertama mengubah persen yang ditanya dalam bentuk pecahan.
- Mengalikan pecahan ini dengan jumlah total yang tersedia
- Jika soal ini adalah soal tentang diskon dan yang ditanya adalah besarnya harga yang dibayar, kita harus mengurangkan harga awal dengan jumlah potongan harga yang diberikan.
- yy. Untuk melengkapi jawaban atau cara kerja yang telah dijabarkannya, siswa diminta untuk membuat contoh soal sendiri (soal cerita).
- zz.Setelah soal tersebut dibuat, siswa diminta untuk mengaplikasikan strategi yang telah mereka buat sebelumnya untuk menyelesaikan soal tersebut.

aaa. Setelah selesai, jawaban yang mereka buat ini, dipertukarkan dengan teman sebelah.

bbb.Masing-masing siswa membaca pekerjaan temannya dan memberikan komentar pada halaman belakang

Komentar ini dapat berupa:

- Apakah strategi yang digunakan siswa ini tepat?
- Bagaimana contoh soal yang dibuatnya? (terlalu susah/terlalu mudah/tidak bisa diselesaikan)
- Bagaimana cara siswa mengaplikasikan strategi dengan soal yang dibuatnya? (sudah tepatkah/ sudah menjawab soal yang dibuatnya)

ccc. Selanjutnya guru mengadakan kembali diskusi kelas.

ddd.Beberapa orang siswa maju untuk menunjukkan hasil pekerjaan mereka dan memberikan penjelasan

eee. Dalam pelaksanaan diskusi ini, diharapkan siswa mampu menampilkan seluruh aspek yang mereka ketahui tentang persen. Selain itu diharapkan siswa mampu membuat aturan umu bagaimana cara menyelesaikan masalah yang berkaitan dengan persen.

#### 3. Penutup

g. Dari kegiatan ini diharapkan siswa muncul dengan beberapa cara yang bisa mereka gunakan untuk menyelesaikan soal yang berkaitan dengan persen.

Guru bertanya strategi apa saja yang bisa digunakan untuk menyelesaikan masalah yang berkaitan dengan persen.

## Alternatif Penilaian

Penilaian proses dapat dilakukan guru dengan melakukan pengamatan terhadap kemampuan siswa menjelaskan pekerjaannya, berdiskusi dengan teman, berargumentasi dalam proses diskusi kelas, dan menjawab pertanyaan guru. Penilaian dapat pula dilakukan guru berdasar pada keaktifan siswa dalam mengikuti kegiatan di kelas.

Palembang, April 2012

Guru Kelas 5E,

Peneliti

Admelia jayanti Adlu, S. Pd

Yenny Anggreini

Menyetujui, Kepala SD Pusri Palembang,

Meliana, A. Md

Aktivitas 2

Nama:

Hari/Tanggal:

Diskon Dua Saudara Kembar

Lila dan Lina baru selesai berbelanja di toko buku. Mereka kemudian membicarakan uang kembalian yang mereka peroleh dri toko buku tersebut.

Lina berkata: "Kita berdua dapat masing-masing diskon 10 persen, tapi kita tidak mendapat uang kembalian yang sama. Aku dapat kembalian Rp4.000,00 dan kamu hanya mendapat uang kembalian Rp1.000,00.

Lila menjawab: "Oh, tidak apa-apa. Hal ini benar adanya."

Pertanyaan: apakah hal ini mungkin, jika kita mendapatkan diskon yang sama tapi mendapatkan jumlah uang kembalian yang berbeda ketika selesai membayar?" Jelaskan jawabanmu!

Nama:

Hari/Tanggal:

<u>Penawaran dengan Harga Termurah Sepanjang Masa</u> Sebuah toko menempel papan pengumuman bertuliskan:



Harga termurah sepanjang masa! 40 persen diskon untuk semua barang!

Apakan ini benar-benar harga termurah? Pemilik toko mengatakan iya, tapi pembeli mengatakan tidak.

Pertanyaan: Dengan siapa kamu setuju, pemilik toko atau pembeli? Berikan alasanmu.

Nama:

Hari/Tanggal:

Masalah Dana

Ketua kelas sedang menjelaskan perkiraan dana yang akan dipakainya selama setahun,: "Lingkaran ini menampilkan perkiraan penggunaan dana: 50 persen dari uang yang ada digunakan untuk pembelian buku, 25 persen untuk membeli makan siang ketika belajar tambahan, dan 35 persen diberikan untuk ketua kelas."

"Tunggu sebentar!" kata bendahara. "Total semuanya adalah 110 persen!"



Biru tua: Pembelian buku Biru: Makan siang Biru muda: Ketua kelas

Pertanyaan: Apakah ada yang kurang tepat dengan perkiraan dana yang dibuat oleh Ketua kelas? Beri penjelasan.
Nama:

Hari/Tanggal:

Diskon untuk Radio



Tio: "Morgan, lihat ke sini. Diskon 25 persen untuk pembelian sebuah radio Rp80.000,00. Kamu tahu, radio ini adalah radio yang sudah lama ingin kubeli. Aku hanya perlu uang Rp60.000,00 sekarang untuk membelinya."

Morgan: "Kamu butuh Rp60.000,00? Sepertinya hal itu kurang tepat."

Pertanyaan: Jika kamu adalah Tio, bagaimana kamu menjelaskan jawabanmu ke Morgan?

Nama:

Hari/Tanggal:

## Perang Harga

Dua orang pegawai toko ponsel sedang membandingkan harga barang di toko mereka masing-masing.



Tokonya Reza menjual sebuah ponsel dengan harga Rp200.000,00. Ponsel dengan jenis dan merek yang sama, dijual di toko Miki dengan harga Rp400.000,00.

Reza berkata: "Harga di tokomu 100 persen lebih mahal!"

"Itu tidak benar," kata Miki. "Harga ditokomu hanya 50 persen lebih

murah."

## Pertanyaan: Siapakah yang benar?

Nama:

Hari/Tanggal:

Ada beberapa pertunjukkan yang diselenggarakan tiap bulan di salah satu gedung di Palembang. Arsirlah pada bagian <u>ruangan penonton</u> berdasarkan gambar yang kamu buat, untuk menunjukkan berapa persen dari ruangan yang menurutmu akan dipenuhi penonton untuk setiap konser

- Konser musik pop
  Semua penonton akan berdiri, tidak ada kursi yang disediakan untuk penonton.
- b. Pertunjukkan sejarah
  Semua penonton duduk dan tidak ada penonton yang berdiri selama pertunjukkan.
- c. Pertunjukkan sirkus
  Ada kursi yang disediakan dan penonton tidak diizinkan berdiri.

Untuk menjaga agar penonton tetap tertib, panitia memberi batas ruangan untuk menonton pertunjukan seperti beberapa gambar berikut. Nyatakanlah dalam persen dan arsirlah bagian yang kamu anggap akan terisi oleh penonton.



Nama:

Hari/Tanggal:

Hotel Swarna Dwipa Palembang terdiri dari sebuah ruangan yang biasa digunakan sebagai tempat pertemuan. Ruangan ini mempunyai 300 kursi. Jumlah ini cukup kecil jika dibandingkan dengan *Sriwijaya Sport Convention Center* (SSCC) yang dapat ditempati empat kali lipatnya. Minggu lalu kedua ruangan ini digunakan sebagai tempat pertemuan para pejabat. Sebanyak 35 persen dari total kursi pada masing-masing gedung terisi. Kira-kira berapa banyak pejabat yang menghadiri pertemuan di <u>masing-masing gedung</u> tersebut?

Nama:

Hari/Tanggal:

Dua klub sepakbola, Persebaya Surabaya dan Sriwijaya FC, bertanding pada pertandingan sepakbola persahabatan. Setelah permainan selesai, pelatih Persebaya Surabaya berkata, "Kita memperoleh penggemar yang lebih banyak pada pertandingan ini dibandingan dengan pertandingan sebelumnya."

"Saya tidak berpikir begitu," kata striker Persebaya Surabaya. "Saya kira, kali ini mereka hanya lebih ribut karena kita menang."

Tentukan apakah pelatih atau stiker yang benar!

Pada pertandingan sebelumnya, ada 1.200 penonton dengan 540 adalah penggemar Persebaya. Hari ini, ada 600 orang penggemar Persebaya di mana total penonton adalah 1.600 orang.

Nama:

Hari/Tanggal:

Jelaskan langkah-langkah yang kamu lakukan untuk menyelesaikan soal yang berkaitan dengan persen.

Berikan contoh masalah yang berkaitan dengan persen untuk menjelaskan langkah-langkah yang telah kamu susun sebelumnya

Selesaikanlah masalah yang kamu buat tersebut dengan menggunakan langkah-langkah yang telah kamu susun sebelumnya.

## Komentar

Nama komentator:

Berikanlah pendapatmu tentang pekerjaan temanmu di halaman sebelumnya.

## **Appendix 8**

Nama:

Hari/Tanggal:

9. Bahan yang digunakan dalam pembuatan kaos kaki terbuat dari campuran wool dan katun. Berapa persen katun yang diperlukan dalam pembuatan kaos kaki tersebut?



- 10. Buatlah gambar untuk menyatakan keadaan berikut,
  - "25 persen dari sekumpulan kelereng berwarna hitam"



11. Agar bisa lulus ujian, Andi harus bisa menjawab dengan benar 50 persen dari semua soal ujian. Ternyata, setelah diperiksa oleh Bu Guru, Andi menjawab salah 10 soal. Menurut pendapatmu, apakah Andi lulus ujian? Berikan penjelasan untuk mendukung jawabanmu.



- 12. Pemerintah memberikan  $\frac{2}{5}$  dari seluruh buku yang ada di sekolah. Berapa persenkah buku yang diberikan tersebut?
- 13. Doni ingin membeli topi baru. Harga sebuah topi adalah Rp30.000,00. Doni mendapatkan potongan senilai Rp3.000,00. Berapa persen potongan yang diperolehnya?



14. Isilah titik-titik berikut. Gunakan kotak yang tersedia untuk menuliskan cara yang kamu gunakan.



15. Pada bulan Aprili, Toko Buku Gramedia memberikan diskon khusus.



Berapakah harga normal sebuah tas yang dijual di Toko Buku Gramedia pada bulan yang



Restoran mana yang memiliki persentase pajak lebih tinggi? Berikan alasanmu.